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INTERNATIONAL PROLIFERATION OF NUCLEAR TECHNOLOGY

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A REPORT PREPARED FOR

THE SUBCOMMITTEE ON ENERGY AND THE ENVIRONMENT

OF THE

COMMITTEE ON INTERIOR AND INSULAR AFFAIRS

OF THE

U.S. HOUSE OF REPRESENTATIVES

NINETY-FOURTH CONGRESS

BY

WARREN H. DONNELLY, Senior Specialist, Energy

AND

BARBARA RATHER, Reference Assistant
Environment and Natural Resources Policy Division
Congressional Research Service
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INTERNATIONAL PROLIFERATION OF NUCLEAR TECHNOLOGY

A report prepared for
The Subcommittee on Energy and the Environment
of the House Committee on Interior and Insular Affairs

By
Warren H. Donnelly, Senior Specialist, Energy
and
Barbara Rather, Reference Assistant
Environment and Natural Resources Policy Division

March 1976

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April 14, 1976

Members of the Committee on Interior
and Insular Affairs
U.S. House of Representatives
Washington, D.C. 20515

Dear Colleagues:

During the past twelve months, this Committee's Subcommittee on Energy and the Environment held a series of hearings on subjects within its special oversight jurisdiction covering "nonmilitary nuclear energy and research and development. including the disposal of nuclear waste,"

The purpose of the hearings was to obtain information on the international transfer of nuclear material and components intended for peaceful uses. The testimony heard by the Subcommittee should assist the Congress in identifying methods of controlling the export of nuclear technology by our commercial nuclear industry, which could ultimately result in impeding the manufacture of nuclear weapons by other nations.

Because this issue is one of the most crucial of our time, I am forwarding to you the enclosed report on the International Proliferation of Nuclear Technology, which was prepared by the Congressional Research Service of the Library of Congress and was based upon our Subcommittee's hearings.

With best wishes, I am

Sincerely yours,

James A. Haley

JAMES A. HALEY
Chairman

Enclosure

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WASHINGTON, D.C. 20515

CHARLES CONKLIN
STAFF DIRECTOR

LEE MC ELVAIN
GENERAL COUNSEL

MICHAEL C. MARDEN
MINORITY COUNSEL

April 12, 1976

The Honorable
James A. Haley
Chairman, Committee on Interior and
Insular Affairs
U.S. House of Representatives
Washington, D.C. 20515

Dear Mr. Chairman:

The Subcommittee on Energy and the Environment requested the Congressional Research Service to prepare the attached report on international proliferation of nuclear technology. The report, prepared by Dr. Warren Donnelly and Ms. Barbara Rather, is based on hearings held by the Subcommittee during the past two years.

I believe that the report and the hearings themselves demonstrate the urgency of our need to expend greater effort to prevent additional nations from gaining the ability to produce nuclear weapons. As the authors indicate, there is a large discrepancy between the expressed level of concern about proliferation and the willingness to incur economic and political costs to stem the flow.

The hearings point the way to at least one type of measure which would have a clear inhibiting effect. This would be to require that any nation receiving reactor fuels from the United States be required to subject all of its nuclear activities to the safeguards of the International Atomic Energy Agency. In addition, I believe that the United States should take all possible steps to discourage the construction of fuel reprocessing or enrichment plants in non-nuclear weapons countries.

The Honorable
James A. Haley

April 12, 1976

I am also encouraged by signs that the proliferation issue is being taken more seriously by various agencies of our government. In particular, I commend the recent action of the Nuclear Regulatory Commission in declining to expedite action concerning a license for export or uranium to India.

The report will be of substantial use to those who seek to understand nuclear proliferation.

Sincerely,

Morris K. Udall, Chairman
Subcommittee on Energy and
the Environment

The Library of Congress
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Washington, D.C. 20540

March 19, 1976

The Honorable Morris K. Udall, Chairman
Subcommittee on Energy and the Environment
Committee on Interior and Insular Affairs
House of Representatives

Dear Mr. Chairman:

I am pleased to forward with this letter a report entitled: "International Proliferation of Nuclear Technology," which was prepared at the request of the Subcommittee.

The report examines the oversight hearings held by your Subcommittee in July 1974, and in April, May and July of 1975, for insights into problems of proliferation of nuclear technology and to identify matters and issues that may warrant further congressional attention.

The analysis was done by Dr. Warren H. Donnelly, Senior Specialist, and Ms. Barbara Rather, Reference Assistant.

We hope that you will find it useful for your continued interest in the subject of nuclear proliferation.

Sincerely,

Norman Beckman
Acting Director

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PREFACE

At the request of the Subcommittee on Energy and the Environment of the House Committee on Interior and Insular Affairs, the Congressional Research Service has analyzed the hearings held by this Subcommittee on international proliferation of nuclear technology. The purpose of this analysis and report is to highlight briefly the problem of the proliferation of nuclear weapons, its characteristics, the role of nuclear exports in proliferation, the international means for limiting further proliferation, and the issues posed for national policy, legislation and congressional oversight. The report opens with a summary of observations. There follow chapters on the challenge of proliferation of the ability to make nuclear weapons, domestic nuclear safeguards, government control of nuclear exports, and the international framework for limiting proliferation.

I. SUMMARY OF OBSERVATIONS AND ISSUES

At the request of the Subcommittee on Energy and the Environment of the House Committee on Interior and Insular Affairs, the Congressional Research Service has analyzed hearings held by the Subcommittee on the international proliferation of nuclear technology. The hearings raised the fundamental question: Can we survive in the nuclear age?

Overall Commentary

On the whole, the hearings indicated a "yes-but" answer to the fundamental question. Avoiding a worldwide nuclear war triggered by small-nation use of nuclear weapons appears reasonably certain but is by no means guaranteed. The chances will increase that more nations may obtain them and possibly use them if there is an uncontrolled expansion throughout the world of the industrial capacity to make and process nuclear fuel materials. In the years ahead, many more nations are likely to possess the means to make nuclear weapons if they choose to do so. Limiting the expansion or proliferation of the means to make nuclear weapons will call for extraordinary diplomatic efforts the success of which cannot be assumed. Also, avoidance of nuclear conflict or disaster will take on new dimensions if terrorist or other extremist groups decide to try to steal nuclear explosive materials to make weapons and if they succeed in doing so.

Many witnesses assessed proliferation as probably the principal problem of the times. Yet few called for radical measures. They opted instead for incremental changes and improvements in ways to limit proliferation.

There is an incongruity between warnings of dire foreboding on one hand, and, on the other, international haggling over who should pay the costs of keeping just 40 international inspectors in the field to assure compliance by free world nations with their commitments to use nuclear materials only for peaceful purposes. If the risks are as grave as seen by some, then radical action is needed, action unlikely to be seriously considered by Congress on the basis of hypothetical situations. If the risks are not of catastrophic imminence, then moderate and incremental measures can be expected to attempt to reduce but not to erase risks of proliferation.

From this viewpoint, probably the most useful congressional oversight will be hard-headed assessment of the risks of proliferation.

Specific Insights

Proliferation and nuclear powerplants.--The risks of proliferation come from the spreading of industrial facilities that can produce fissionable materials of weapons quality, not from the spread of nuclear powerplants alone. The normal or slightly enriched uranium used in most contemporary power reactors are not nuclear explosives. The used fuels from these reactors do contain the nuclear explosive plutonium, but as long as the plutonium is not separated, it remains protected by the intense radiation characteristic of used fuel. Highly enriched uranium and uranium-233 also can be used as nuclear explosives.

Proliferation and the nuclear fuel cycle.--If plutonium, highly enriched uranium, or uranium-233 become practical nuclear fuels in the future, then there will have to be industrial plants to produce and use these materials.

The spread of such facilities will increase the prospects that nations possessing them can quickly make nuclear bombs, or that terrorists can find a weak link where they might steal these materials. If and when that time comes, the safest place for nuclear fuel materials will be inside an operating reactor.

Safeguarding nuclear materials and facilities.--If nuclear power is to be used widely throughout the world, then effective measures to deter diversion of nuclear materials from civil nuclear power to clandestine national manufacture of nuclear weapons, and to prevent theft of nuclear materials by terrorist or other subnational groups become increasingly important. In the nuclear age, "safeguards" refers to systems of equipment, personnel and procedures designed to discourage the further spread of nuclear weapons by assuring early detection and announcement of diversion or theft of nuclear materials from safeguarded uses. Safeguards are not designed to detect clandestine production of nuclear weapons materials from non-power sources. Safeguards systems are applied by some but not all individual nations. The International Atomic Energy Agency (IAEA) also can, upon request, apply safeguards to nuclear materials in specified facilities in some countries or to all peaceful uses of nuclear materials in other countries that have ratified the Treaty on Non-Proliferation of Nuclear Weapons (NPT). Note: there is no blanket commitment by all nuclear nations to place all of their nuclear activities under IAEA safeguards, or to use nuclear materials only for peaceful purposes. The United States, the Soviet Union, the United Kingdom, France and China all possess nuclear weapons and continue to make them. India has tested a "peaceful nuclear explosive." The

United States' concept of safeguards also includes security measures to prevent theft of nuclear materials or sabotage of nuclear facilities. Other countries and the IAEA limit their concept of safeguards to detection and announcement of diversion or theft. For them protection of nuclear materials is a normal police-type function. Whether the United States can persuade other nations to incorporate U.S. physical security concepts into their safeguards systems remains to be seen.

On the whole, the hearings would support the conclusion that present national and IAEA safeguards appear reasonably sufficient to assure detection and announcement of diversion for world nuclear power fueled with natural or slightly enriched uranium. However, the world's safeguards systems appear inadequate in manpower, equipment, funding and access of inspectors to provide the same assurance of detection and announcement if and when highly enriched uranium, uranium-233 or plutonium become widely used as nuclear fuels. Also, IAEA and related national safeguards systems do not assure minimum standards for protection against theft or sabotage by subnational groups. Finally, IAEA safeguards are not backed by prescribed, credible sanctions against nations that divert materials from civil nuclear power, or that abrogate their commitments not to use nuclear materials to make bombs.

As for the United States nuclear industry, it remains to be seen whether safeguards based upon a regulatory approach, with all the attendant problems of opposition, delay and minimal compliance, will be sufficient. If the current U.S. system is found lacking, then a return to direct Government

ownership of all fissionable materials and direct Government operation of safeguards systems within the United States may become necessary. At present, most of the weapons-grade materials in the United States are under safeguards of the Energy Research and Development Administration (ERDA) and its contractors, rather than under regulatory controls of the Nuclear Regulatory Commission (NRC).

Much has been said about the safeguarding of nuclear materials and facilities from diversion or theft and from attack or sabotage. It was clear in the hearings that no safeguards system can prevent the diversion or theft or clandestine production of fissionable materials. Nor can safeguards absolutely guarantee that every theft or diversion, no matter how small, will always be detected. As the volume of nuclear materials in commerce increases, the chance of undetected diversion or theft will increase. The best that can be hoped for is assurance that diversion or theft will be made hard enough to discourage attempts, and that attempted or actual diversion or theft will be detected and announced early enough for effective remedial action.

Proliferation and "peaceful nuclear explosives."--The idea of "peaceful nuclear explosives" has fascinated many engineers. At the moment no nation is using peaceful nuclear explosives (PNE) for civil engineering purposes. The Soviet Union, however, continues to show interest in nuclear explosions for large-scale earth-moving projects. Moreover, the use of PNE devices is made legitimate by the NPT. Article 5 of the Treaty obligates the parties to undertake that "potential benefits from peaceful

applications of nuclear explosions will be made available to non-nuclear weapons states Party to the Treaty on a non-discriminatory basis" and that the charge to such Parties will be "as low as possible." The article specifies that the benefits of PNEs shall be obtained "pursuant to a special international agreement or agreements," and committed NPT Party states to start negotiating such agreements as soon as possible after the Treaty entered into force. These negotiations have been going on since October 1974 but are not yet completed. The emphasis in Article 5 on non-discriminatory supply of PNE services at low cost reflects the optimism of nuclear engineers in the late 1960s that these devices had a promising future, an optimism which has largely disappeared in the United States. Although the prospects for practical use of PNE devices in the United States has declined greatly since the NPT entered into force, the IAEA is preparing future arrangments to govern their use and at some time in the future other nations may approach the United States, the Soviet Union, the United Kingdom, France, or perhaps even India, for PNE services.

The commercial use of PNEs is expected to increase the probability of further proliferation of new types of nuclear weapons, or vertical proliferation, as well as the probability that other nations might start to make so-called peaceful devices. The Government of India in testing a nuclear explosive in May 1974 took the position that it was not contributing to proliferation of nuclear weapons because the device it tested was designed for peaceful uses. Future use of peaceful nuclear explosives can increase the probabilities of proliferation of new weapons by the nuclear weapons nations.

The challenge of proliferation.--There is now no way to prevent more countries from acquiring nuclear weapons if they want to. Even if all nuclear materials in the world were gathered up and buried deep in the sea, all nuclear scientists and engineers isolated from society, and all nuclear facilities and mines dismantled, the knowledge of fission in uranium and plutonium is all that other scientists and engineers would need to recreate the situation that exists today. So with less drastic measures, proliferation cannot be stopped. It can be slowed down and made less attractive to nations that might be tempted to make nuclear weapons. Herein lies the challenge of proliferation: How to limit and slow the further spread of the capability to produce nuclear materials for nuclear weapons. The objective is to gain time to create international conditions that can remove or reduce pressures upon nations to opt for nuclear weapons.

Control of nuclear exports.--Limiting or preventing the export of plant, equipment and technology for sensitive nuclear fuel facilities (enrichment and reprocessing) is one powerful way to slow the pace of proliferation. The United States has engaged in informal diplomatic efforts to convince world nuclear suppliers to agree upon such limitations, but with limited success. Some nuclear nations still are not agreed to halt export of sensitive nuclear fuel technology and equipment. As for the United States, it has policies and procedures to control such exports. Some policy and organizational changes appear to be needed. Some Members of Congress believe such changes should not reduce the authority of the Nuclear Regulatory Commission to make a final, independent decision upon specific nuclear exports.

Leverage from the United States position in the world nuclear market.--The United States until recently enjoyed international influence derived from its virtual monopoly of free-world uranium enrichment. That monopoly is breaking up now that the Government's enrichment plants are fully booked and new enrichment capacity cannot be added for many years. Meanwhile, some other nations are building their own enrichment facilities. The Soviet Union also has moved into the world enrichment market, although whether it can give good commercial service remains to be seen. Also, the U.S. position is affected as other industrial nations offer improved nuclear powerplants, frequently based upon U.S. technology. The emergence of Canada as an exporter of nuclear powerplants that use natural uranium for fuel and the prospects that the United Kingdom may offer such reactors can also diminish the future U.S. share of the world nuclear power market.

The weakened market position for the United States would mean both loss of income from foreign sales, and loss of influence over the policies of nations using nuclear power.

The international framework for nuclear exports and proliferation.--A well established international framework now exists for U.S. nuclear exports. The United States has a far-flung web of international agreements for cooperation which provides the basis for commercial export orders. The Department of State and the Energy Research and Development Administration negotiate the fundamental agreements for nuclear cooperation. Within these, the Nuclear Regulatory Commission and the Department of Commerce govern the export of physical things; ERDA governs the export

of the most sensitive nuclear power technologies; and the Export-Import Bank finances most of the U.S. exports of nuclear powerplants. This framework exists, however, at the forebearance of other governments and could easily be disrupted. It is not strong enough now to prevent the export of critical nuclear technologies by other countries nor can it support substantial sanctions against those nations that divert nuclear materials from peaceful to military uses.

Potential Measures for Limiting Proliferation

Many United States initiatives can be proposed to limit further proliferation of the ability to make nuclear weapons and national decisions to do so. Most would require legislation and subsequent oversight to see how well they are carried out. Major approaches to curbing weapons proliferation which emerged from the hearings include the following:

Reducing pressures for proliferation.--Diplomatic initiatives could seek to reduce world tensions and to provide for resolution of conflicts between nations without resort to armed force. This would reduce pressures on governments to make nuclear weapons. Conceivably, the International Atomic Energy Agency could also help to persuade nations not to acquire nuclear weapons by supplying them with technical advice and assistance on alternative non-nuclear sources of fuels and energy, and by increasing their confidence that the world community of nations will be informed of diversion of nuclear materials early enough to take remedial action.

Fostering nuclear interdependence.--Many nations now see nuclear independence as a solution to their problems with the supply of oil from

highpriced and potentially unreliable sources. Nuclear independence, however, means the acquisition of nuclear fuel cycle capabilities which could be diverted to production of weapons. One way to limit this spread of the nuclear base is to encourage the alternative of nuclear interdependence. Interdependence would make nations less likely to take unilateral actions contrary to peace. Interdependence would be promoted by construction and operation of multinational, regional nuclear fuel cycle facilities, as has been proposed by Secretary Kissinger.

Limiting the export of critical nuclear capabilities.--Another way to limit proliferation is for the United States to persuade other nuclear exporting countries not to export the technology, plant or equipment needed to produce or reprocess nuclear fuels, or special materials used in such facilities, such as heavy water. Controlling the international spread of laser enrichment technology and centrifuge technology can become a proliferation problem if either technology should prove practicable.

For U.S. nuclear exports, a decision appears to be needed whether the United States should attempt to set an example for the world, or whether it should adopt export policies and controls agreeable to other nuclear supplier nations. If the former approach is chosen, then the United States could unilaterally consider such measures as:

(1) Prohibition of export of the technology, plant and equipment to produce weapons-grade nuclear materials.

(2) Prohibition of nuclear exports to any nation which will not agree to put all its nuclear activities under IAEA safeguards, excluding perhaps those nations that already possess nuclear weapons.

(3) Prohibition of the export of nuclear powerplants for applications without economic justification.

(4) Requirement of a proliferation impact analysis by the Arms Control and Disarmament Agency as a prerequisite for major exports. If this approach is chosen, then the United States would focus its efforts on persuading the nuclear supplier nations to adopt its position, and limit unilateral actions that could reduce the U.S. position in the world nuclear market.

Strengthening the International Atomic Energy Agency.--Some kind of international safeguards appears necessary to deter diversion of nuclear materials from civil power use by high risk of detection. Despite its limitations, the IAEA exists and is accepted by virtually all nations. Many measures can be proposed to strengthen the IAEA and to improve its safeguards system and technologies. However, before individual measures can be considered, it is necessary for the United States to decide the answers to several key policy questions: What does the United States really expect from the Agency? How far is it willing to support the IAEA diplomatically and financially? Would the United States yield some sovereign powers to the Agency as an example to other nations? What are the prospects of persuading other IAEA members to support our ideas?

As mentioned earlier, it seems incongruous on one hand for proliferation to be described as the foremost long-term problem of these times, and on the other hand, to see member nations of the IAEA haggling over whether 40 inspectors are enough to safeguard the world use of nuclear power and who should pay for the costs of safeguards.

The whole subject of ways to strengthen the IAEA and its functions merits further attention.

II. HEARINGS OF THE SUBCOMMITTEE ON ENERGY AND THE ENVIRONMENT

On July 21, 1975, the Subcommittee on Energy and the Environment opened three days of hearings on the proliferation of nuclear technology,* a subject which Chairman Morris K. Udall characterized as perhaps the ultimate question facing civilization: Can we as a people survive the nuclear age? The Subcommittee had laid the groundwork for these hearings in its earlier hearings of April and May 1975 that provided an overview of major issues of nuclear energy.**

The Problem of Proliferation

Briefly put, the problems of the proliferation of nuclear weapons and the industrial ability to make them, and the prospects--small though they now appear--for terrorist or extremist use of nuclear explosives, appear as a grave new risk to threaten world peace and society. If more nations, or irresponsible groups, or perhaps irresponsible or unstable individuals, come into the possession of nuclear weapons, prospects for world peace will become increasingly unstable. Some analysts fear that use of nuclear weapons by smaller nations could trigger a general nuclear war of the

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* U.S. Congress. House. Committee on Interior and Insular Affairs, Subcommittee on Energy and Environment. Hearings. Oversight Hearings on Nuclear Energy--International Proliferation of Nuclear Technology. 94th Cong., 1st sess., July 21, 22 and 24, 1975, Part III, 118 p. Hereafter referred to as the July hearings.

** U.S. Congress. House. Committee on Interior and Insular Affairs, Subcommittee on Energy and the Environment. Hearings. Oversight Hearings on Nuclear Energy--Overview of the Major Issues. 94th Cong., 1st sess., April 28, 29; May 1 and 2, 1975, Part I, 901 p. Hereafter referred to as the April-May hearings.

kind speculated about by Herman Kahn in the 1960s* or substantial and unpredictable shifts in world balances of power that could result from a limited use of nuclear weapons between known or unknown adversaries. The consensus holds that further weapons proliferation can produce intolerable tensions among nations. Thus measures are urgently required to prevent if possible, or at least to slow down further proliferation until the world can devise the institutions needed to live with nuclear explosive materials in reasonable safety, or a practicable substitute for nuclear power can be developed and applied.

Background of the Hearings

The hearings were held at a time when ominous developments in the proliferation of nuclear technology were causing renewed concern in Congress and in the executive branch. To date, one nation has used nuclear weapons--the United States. Four more have tested nuclear weapons--the Soviet Union, the United Kingdom, France and China. Most recently, India (in May 1974) tested a nuclear explosive which it insists was designed for peaceful purposes. The anticipated acceleration in the production and use of nuclear fuel materials and associated facilities for civil purposes during the 1980s and beyond can greatly increase the probability that more

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* In 1962 Herman Kahn published his Thinking about the Unthinkable. (New York: Horizon Press, 1962, 254 p.) In it he made the case for hard thinking about the realities of thermonuclear war. "We must at least ask ourselves," he wrote, "What are the likely and unlikely results of an inadvertent war, the possibilities of accident, irresponsibility, or unauthorized behavior on the other side as well as on our own?" His analysis then focussed upon the possibilities of nuclear war between the United States and the Soviet Union. Proliferation will greatly expand the problem by introducing new and perhaps less stable participants.

countries will produce nuclear weapons or acquire the industrial base to make them quickly. Increased also will be the number and location of places where dissident groups could try to steal nuclear materials or sabotage nuclear facilities. To counter and limit the risks of further nuclear proliferation, the United States and other nations have entered into a Non-Proliferation Treaty (NPT). However, some analysts fear that countries which have not signed the NPT could acquire the necessary materials and technology for nuclear weapons, and that NPT countries could abrogate their commitments after they have acquired nuclear materials and facilities useful for the production of nuclear weapons.

Chairman Udall noted that as the Subcommittee prepared for the hearings on proliferation, it became clear that what is required is the strongest possible international pressure to guarantee that no nation can use a newly acquired nuclear technology to create nuclear weapons. Also of utmost importance are strict international controls, or safeguards, to prevent nuclear materials capable of being used in a nuclear explosive from being diverted by governments or stolen by terrorists. Critical to prospects of future proliferation are national and international policies and controls for export of certain nuclear products and technology.

As a major world supplier of nuclear technology, it would seem desirable for the United States to take the lead in insisting on stringent conditions and enforceable safeguards on the international sale of nuclear components and materials. However, the responsibility for devising and

implementing current U.S. nuclear export policies is divided among several agencies. The United States through its foreign policy can play a major role in formulating new international policies to effectively limit proliferation of nuclear weapons by States that now do not have them. In opening the hearings, Chairman Udall identified four major options for the United States for improving international safeguards and controls over exports of nuclear materials, facilities and technologies. He said:

> First, this Nation should seek to strengthen the IAEA to insure that its safeguards function is adequately carried out.
>
> Second, the United States should cooperate with other exporting states in obtaining strict safeguard agreements from all receiving states. Common problems of reactor safety and radioactive waste disposal should also be addressed on an international basis.
>
> Third, the possibility of placing enrichment and reprocessing facilities under international control in regional centers should receive serious early consideration. Exporting nations should seek ways to guarantee adequate supplies of nuclear fuel so as to discourage other nations from developing such facilities.
>
> Fourth, I believe that the United States should concentrate on a long-range energy policy which would allow all nations to develop safe alternative energy sources in the hope that nuclear fission needs only be an interim solution to the world electrical energy needs.

Purpose of the Hearings

The hearings were planned to obtain information and insight from Federal agencies and from the nuclear industry about the international framework in which nuclear exports take place, the policies and processes for U.S. export controls, and the technological and foreign policy challenges of these exports for control of nuclear weapons proliferation. Special attention was given to the adequacy of safeguards of the International Atomic

Energy Agency (IAEA), and to procedures for commercial contracts and government licenses for exports.

Organization of the Hearings

The Subcommittee invited testimony for its April-May 1975 hearings from three Federal officials, a corporate officer of a major nuclear company, a leading analyst and critic of U.S. safeguards policies and programs, and a leading analyst of U.S. arms control and disarmament programs. In order of appearance, the witnesses and the main subjects they addressed were as follows:

Mr. Myron B. Kratzer, Acting Assistant Secretary of State for Oceans and International Environmental and Scientific Affairs, U.S. Department of State, on the background and rationale for U.S. international cooperation in nuclear energy.

Dr. Abraham S. Friedman, Director, Division of International Programs, U.S. Energy Research and Development Administration, on the general framework in which U.S. activities for international cooperation in nuclear matters are carried out, and an overview of U.S. and foreign exports of materials and equipment.*

Dr. Victor Gilinsky, Commissioner, U.S. Nuclear Regulatory Commission, on licensing of exports of nuclear materials and facilities.

Mr. A.L. Bethel, Vice President and General Manager, Water Reactor Division, Westinghouse Electric Corp., on the company's role as a manufacturer of nuclear power equipment.

Dr. Theodore B. Taylor, Chairman of the International Research and Technology Division of General Research Corp., on possible technological and policy solutions to nuclear proliferation.**

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* Dr. Friedman is now a U.S. science attache for the State Department in Mexico.

** Dr. Taylor is now an independent consultant.

Dr. Herbert Scoville, Jr., former Assistant Director for Science and Technology of the Arms Control and Disarmament Agency, on control of nuclear technology.

In the Subcommittee's July 1975 hearings, it heard testimony from seven witnesses who included a ranking Federal official, four scientists or scholars from leading universities, a nuclear weapons expert and the counsel for a public interest group. The witnesses were:

Professor Hans A. Bethe, Professor of Physics, Cornell University, on the hazards of diversion of plutonium and of nuclear accidents.

Ms. Anne Hessing Cahn, a research fellow of the Harvard University program of Science and Technology, on what the United States could and should be doing to establish international incentives for countries not to pursue the nuclear weapons option, or to limit or delay their capabilities to do so.

Dr. Victor Gilinsky, Commissioner, U.S. Nuclear Regulatory Commission, on safeguarding nuclear materials.

Professor Wolfgang K. H. Panofsky, Professor of Physics at Stanford University, on the potential applications of so-called peaceful nuclear explosives, their limitations and their implications for further proliferation.

J. G. Speth, Esq., representing the Natural Resources Defense Council, on the NRDC's analysis of the prospects for nuclear theft and diversion to weapons, the adequacy of safeguards and why the Council would ban the use of plutonium.

Dr. Theodore B. Taylor, on the risks and benefits associated with the further development of nuclear power, with special attention to the risks of theft or diversion of nuclear materials and the prospects that safeguards could reduce these risks.

Professor Mason Willrich, of the University of Virginia, on legal aspects of arms control, disarmament and safeguards, and the regulation of international nuclear commerce.

III. THE CHALLENGE OF NUCLEAR PROLIFERATION

In three brief decades, civilian nuclear power has grown from speculation of scientists and engineers engaged in making atom bombs for the United States into a demonstrated technology in use in major industrial nations and on the brink of expansion into many developing nations. Civilian nuclear power, despite questions of safety, costs and uranium supply, appears to promise to many nations some relief and independence from increasingly expensive supplies of oil from potentially unreliable sources. So there are prospects for a revived international market for nuclear exports by the leading industrial nations and growing competition to sell nuclear powerplants and associated fuels and services. United States' interest in this market is keen because of cancellations and delays of nuclear projects on the domestic front and dim prospects for new sales of nuclear powerplants for the present. The prospects for income and employment for nuclear exporting countries and a happier energy situation for nuclear importing nations are attractive indeed. Yet these prospects are overshadowed by a growing concomitant danger, a growing risk that more nations will become able to make nuclear weapons and that they may do so. The spread of nuclear powerplants alone is not of great proliferation concern. Rather, it is the spread of the industrial nuclear base, the ability to produce weapons-quality materials. Herein lies the risk of nuclear attack by one nation upon another, or of worldwide nuclear war if the United States and the Soviet Union were to be dragged in, and the risk of terrorist groups stealing

nuclear materials to make into crude atomic bombs or other destructive devices. A growing challenge of the mid-1970s is to find ways to limit further spread of the ability to make nuclear weapons and its attendant risks. How this can be done is a matter that has become important to the Congress as well as to the Administration. As seen by Dr. Theodore B. Taylor, the most critical task facing the world is to establish, within a very few years, worldwide controls that will reduce the risks of nuclear explosives to acceptable levels.*

In principal there are three broad, divergent approaches to limiting or stopping proliferation. They are to attempt to:

(1) Stop and suppress use of nuclear power, or

(2) Freeze world nuclear power at present levels, or

(3) Limit further proliferation, permit continued growth of civilian nuclear energy in the world under improved safeguards and measures to reduce pressure for proliferation.

In today's world energy circumstances and considering that the United States has lost much of its nuclear monopoly, the first two approaches imply a substitute for civilian nuclear energy, a substitute independent of world oil supplies and sufficiently demonstrated and established to permit immediate large-scale use. No such substitute now exists. Perhaps the world's scientists, engineers and industrialists can produce an alternative within a few decades. But meanwhile, civilian nuclear power seems likely

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* July hearings, p. 73.

to grow and spread, at least until a catastrophic accident or misuse of nuclear materials causes the world community to decide that the risks of civil nuclear power outweigh its benefits. The third approach implies the world can learn to live with some proliferation until it finds a long-term solution. The world is already far down the road of nuclear power and is close to the point of no return. The next few years will provide a last chance to deal with nuclear power and the risk of proliferation.

The Status of Proliferation

Today five countries--the United States, the Soviet Union, Great Britain, France and the People's Republic of China--have developed and tested nuclear weapons. Of these, all but China have substantial civilian nuclear power industries. An additional country, India, has tested a nuclear explosive which it describes as a peaceful device. On the other hand, as seen by the Administration, the acquisition of nuclear weapons and nuclear explosives capability have been impressively limited.*

The Administration attributes this situation in large measure to U.S. policies and active U.S. leadership directed toward avoiding the development of national capabilities to acquire nuclear weapons.** Secretary Kissinger in his speech of September 23, 1974, to the United Nations General Assembly emphasized this goal when he said, in part:

> In a world where many nations possess nuclear weapons, dangers would be vastly expanded...The challenge before the world

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* Statement by Myron B. Kratzer, Department of State, July hearings, p. 3.

** Ibid.

is to realize the peaceful benefits of nuclear technology without contributing to the growth of nuclear weapons or the number of states possessing them.*

The State Department acknowledges that the risk of further proliferation seems greater and more immediate than at any time in the past. Yet it sees in the experience of the last two decades the lesson that proliferation is not inevitable and can be avoided.**

Other observers are not as optimistic. Physicist Bernard T. Feld noted it is all too easy to conclude that we have already passed the point of no return for nuclear proliferation. He is not yet ready to pronounce non-proliferation dead, but warned there is little time left and that there may still be some ways of frustrating the apparently inevitable if we can concentrate our collective intellectual and political efforts on the problems.***

Commissioner Victor Gilinsky of the Nuclear Regulatory Commission expressed his concern at the hearings that the advance of civilian nuclear power programs throughout the world will bring increasing numbers of countries technologically closer to the nuclear weapons threshold. For three decades there have been warnings of nuclear proliferation. Now, in his view, "uncontrollable nuclear proliferation threatens to become a reality."

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* July hearings, p. 3.

** Ibid., p. 9.

*** Cf., Bernard T. Feld. Nuclear proliferation--thirty years after Hiroshima. Reprinted in the July hearings, p. 104.

The measures taken over the years to prevent or at least contain proliferation apparently have not been enough.*

Dr. Theodore B. Taylor summed up the central issue of proliferation in terms of negating the pressures for proliferation:**

> The central issue that must be faced and acted on, I believe, is this: How can all countries that do not now have nuclear weapons be convinced that they will be less secure if they do so as long as five and perhaps six, large countries all behave as though they feel more secure with large numbers of nuclear weapons than without them? Until this issue is dealt with honestly and openly, undiluted by rhetoric, I am convinced that the pressures to proliferate will continue to increase, as will the dangers of outbreak of nuclear war.

Dr. Taylor saw real possibilities for technological measures to the problem of keeping nuclear weapons out of the hands of terrorists and criminals, but not for keeping them out of the hands of governments that really want them for military purposes.***

Mechanisms of Proliferation

A fundamental fact for limiting nuclear proliferation for the 1970s and beyond is that almost any nation with funds and some industrial capability can make its own nuclear materials and fashion them into useful, even though not the most efficient or powerful, nuclear weapons.

Dr. Taylor identified at least nine ways in which a country could acquire materials for fission-type atom bombs. These drive home the point that

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* July hearings, p. 48.

** Ibid., p. 76.

*** Ibid.

there is a variety of ways to acquire the nuclear materials for weapons. Table I gives the details. Dr. Taylor put it bluntly: "Any country that really wants nuclear weapons during the next few decades will be able to acquire them, one way or another."*

A recently noted dimension of proliferation is the risk that non-national organizations might covertly divert or openly steal weapons-grade materials from civilian or military nuclear fuel cycles to make their own crude explosive or radiological devices. This risk is of special concern to the Subcommittee because nuclear threats by terrorists, for example, are unlikely to be deterred by a threat of nuclear retaliation and because physical security for such materials in the United States and in other countries is not yet adequate to prevent theft from all places where substantial quantities of weapons-grade materials exist.**

Troublesome Cases

Most countries do not have nuclear weapons and the greater part of these do not appear to be under pressure to acquire them. The industrial nations of Europe that now lack weapons seem uninclined to seek them. Rather, the greatest risk of further proliferation lies with a number of developing or smaller countries. Five cases of special interest to the Subcommittee were Brazil, Egypt, Iran, and Israel.

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* Ibid., p. 75.

** Dr. Taylor made this assessment for the Subcommittee. Ibid.

Table I

SOME OPTIONS FOR A COUNTRY TO OBTAIN
NUCLEAR MATERIALS FOR WEAPONS

1. Build its own uranium enrichment facility

2. Build a plutonium production reactor using natural uranium for fuel with heavy water, carbon or beryllium as a moderator

3. Build a neutron generator to transfor uranium into plutonium

4. Build a reactor that uses imported fuel and divert some fresh fuel if not effectively safeguarded. If the reactor is not effectively safeguarded, extract fissionable materials from used fuels

5. Obtain a reactor or assistance in building one and exercise option 4, above

6. Import a reactor and fuel and, if effectively safeguarded, later abrogate the supply agreement with its safeguards

7. Arrange for theft of weapons-grade materials from a country where physical security for nuclear materials is inadequate

8. Arrange for theft of weapons-grade materials from facilities within the country and subject to safeguards so that the theft appears to be the work of others

9. Arrange for theft of complete nuclear weapons from another country

Source: Statement of Dr. Theodore B. Taylor, July hearings, p. 74.

Brazil.--The recent agreement by West Germany to supply Brazil with nuclear powerplants plus a complete nuclear fuel cycle has aroused considerable concern. Since Brazil has not ratified the Non-Proliferation Treaty, it has no treaty commitment not to make nuclear weapons, or to place all of its nuclear activities under IAEA safeguards. Brazil is party to agreements with the Government of West Germany and with the IAEA which commit it not to use the German nuclear exports for weapons or other military purposes. The United States, according to the State Department, made strong representations against the agreement to export fuel reprocessing and enrichment technology, but without success. In terms of potential weapons proliferation, it would have been better if this deal had not been made, or if the West German Government had insisted Brazil ratify the NPT or at least agree to put all nuclear materials and facilities in Brazil under IAEA safeguards. However, the agreement does have some interesting and valuable safeguards arrangements. It requires Brazil to submit technological know-how to IAEA safeguards as well as all nuclear equipment, installations and materials supplied. This is the first attempt to safeguard technological know-how.*

Egypt.--Of particular interest to Congress is the pending agreement of cooperation with Egypt, which originated in the proposal of President Nixon to supply both Israel and Egypt with nuclear powerplants as one inducement for them to end their hostilities.

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* July hearings, p. 78.

On November 5, 1975, Secretary of State Kissinger and Egyptian Deputy Prime Minister Fahmy agreed in principle to conduct a program of cooperation in peaceful uses of atomic energy. The joint statement notes that Egypt will be able to purchase from the United States nuclear power reactors with an electrical generating capacity of 1200 megawatts and also the slightly enriched uranium to fuel these plants. This cooperation is to be under terms of an agreement for nuclear cooperation which will be: "fully compatible with the non-proliferation objectives of the two Governments." The conditions of the agreement will be designed to assure that U.S.-supplied facilities, materials, and their products, as well as the associated relevant technology, are used for peaceful purposes only. It is to include provisions to ensure that:*

a. None of the assistance provided will be employed for any military purposes, including the manufacture of any nuclear explosive device.

b. The materials and facilities to be supplied as well as the produced plutonium will be subjected to international safeguards, administered by the International Atomic Energy Agency, designed to assure their continued uses for peaceful purposes.

c. The plutonium produced in the agreed-upon 1200 MWe power reactors under the agreement, or derived from U.S. fuel supplied for these facilities will be reprocessed, fabricated and stored outside Egypt.

d. Facilities utilizing relevant nuclear technology obtained from the United States will be under effective safeguards.

e. The Government of Egypt guarantees to apply effective physical security measures to the facilities and nuclear material covered by the agreement.

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* Department of State release no. 533, November 4, 1975. The release includes the text of the joint statement.

The statement also specified that the same safeguards will be applied in and agreement for nuclear cooperation between the U.S. and Israel.

Israel.--One nation of scientific and technological strength which has yet to test nuclear weapons but which some analysts see as able to quickly acquire weapons is Israel. During the hearings witnesses were asked about evidence whether Israel has nuclear weapons. The Administration witnesses said they had no evidence that this was so, and that they had evidence Israel had never tested a nuclear weapon. They acknowledged that Israel built a reactor in an isolated part of the country, the Damona reactor, which for some time was kept in a very confidential status. This reactor was not supplied by the United States and is not subject to any international inspection or control.* The State Department suggests the existence of this reactor leads to the frequent speculation that it may have been used to produce materials for nuclear explosives. The witness from industry had no evidence one way or another, but agreed that Israel could develop a weapon without outside assistance. The frankest answers came from Dr. Scoville and Dr. Taylor. The former noted that while he was confident the United States would know if Israel had tested a weapon, for a first generation weapon, or a simple one, no test is necessary. He suspected that Israel is at the point where it has all the parts for a weapon but may never put them together.**

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* Cf., statements of M. Kratzer, Department of State, in July hearings, p. 19, and A. Friedman, ERDA, ibid., p. 38.

** July hearings, p. 92. It was reported that senior officials of the Central Intelligence Agency estimate that Israel has 10 to 20 nuclear weapons ready for use. Cf., Kranish, Arthur, Washington Post, March 15, 1976: A2.

Dr. Taylor estimated that the Damona reactor might produce about a dozen kilograms of plutonium a year if run at maximum output, which could give the Israeli Government a small stockpile of plutonium. Reflecting upon his experience in weapons design and upon the high quality of the Israeli physicists and engineers. He thought there might be a very good possibility the Israelis have become very sophisticated in the development of weapons that require small amounts of plutonium, without giving any inkling of what is going on.*

Peaceful Nuclear Explosives

The notion that there can be "peaceful nuclear explosives" (PNEs) is another factor in the proliferation of nuclear weapons. By labelling its explosive device as "peaceful", the Indian Government sought to avoid some of the opprobrium of testing nuclear weapons. Clearly, the explosive force of fissioning uranium and plutonium is amoral and its physical and environmental effects do not depend on the intentions of the person who triggers the device. Any nation which can make a peaceful nuclear explosive has a nuclear weapon in hand. So the development of PNE devices by non-weapons nations is just as much to be avoided as the direct, uncamouflaged development of weapons themselves.

Nonetheless, there is a plausibility for PNEs that has made their potential use a matter of interest in some countries.* This interest is supported in Article V of the Non Proliferation Treaty which obligates all Parties to make available the potential benefits of PNEs on a non-discriminatory

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* Ibid.

basis to non-nuclear nations.* Professor Panofsky warned that this clause has been misinterpreted by PNE proponents to constitute a positive mandate to expand PNE activities. Both from the history of the treaty and its formal interpretation, he concludes that the commitment under the treaty is only to share equitably economic benefits of PNEs, if any, with non-nuclear nations. It is in no way a positive obligation toward developing new PNE opportunities.**

Moreover, it is by no means clear that use of PNEs could be compatible with the attainment of a comprehensive nuclear test ban (CTBT) that since 1963 has been a publicly quoted policy objective of all U.S administrations, provided a test ban can be adequately verified. This is exactly the problem now being tackled by U.S and Soviet negotiators in relation to the 1974 Threshold Test Ban Treaty. It appears most difficult, perhaps impossible, to design a comprehensive test ban which would not not also prohibit PNEs outright. Nuclear weapons tests serve several purposes:

1. Development of new military explosive devices.
2. Verification and proof testing of weapons from stockpiles.

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* Dr. Panofsky listed six frequently considered applications of PNEs, none of which have reached the stage of practical use: (1) Retorting oil shale in situ after having fractured underground oil shale deposits by PNEs; (2) creating underground storage cavities; (3) the stimulation of flow of natural gas bound in "tight" gas formations; (4) the fracturing of copper and other ores in situ for extraction by leaching; (5) the generation of electricity from heat released underground by a PNE and/or by recovering underground geothermal heat over a contact area enlarged by PNEs; (6) excavation of large engineering projects such as canals, harbors, etc. Cf., April-May hearings, p. 727.

** Ibid., p. 731.

3. Tests to show the effect of nuclear weapons on systems of military interest.

It is not clear how a comprehensive nuclear test ban treaty can be designed to permit peaceful nuclear explosions without at the same time opening a loophole for camouflaged development of weapons.

Considering the testimony heard by the Subcommittee on the use of peaceful nuclear explosives and their relation to proliferation, it appears that substantial reasons exist to find alternatives to PNEs for use by non-weapons countries and to discourage their use by any nation.

IV. DOMESTIC NUCLEAR SAFEGUARDS

The U.S. civilian nuclear industry operates within a framework of regulations to detect and to prevent theft of nuclear materials. Collectively, these measures constitute the safeguards systems for licensed facilities and materials. These requirements interact with and influence possible limitations and requirements imposed upon U.S. nuclear exporters. Domestic safeguards will be briefly described in this section as background for analysis of export controls in the next.

Dimensions of the U.S. Safeguards Problem

The dimensions of the U.S. safeguards problem are determined by the quantity of licensed nuclear materials held by the nuclear industry. In fiscal year 1975, 28 facilities held licenses to possess more than one kilogram of enriched uranium or plutonium and 74 shipments were made of privately owned materials involving about 2,000 kilograms. By 1980 the Nuclear Regulatory Commission expects the annual number of shipments to double and to include about five times as much materials. If commercial use of plutonium comes to pass, NRC anticipates that by the end of the century as much as 300,000 kilograms of this material would be flowing through the nuclear industry. According to the NRC, "This increased flow and the resulting increase in stock of SNM, would substantially alter the nature of our safeguards problem from that which exists today."*

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* U.S. Congress. Joint Committee on Atomic Energy. Hearings. Nuclear Regulatory Commission Authorizing Legislation, Fiscal Year 1976. 94th Cong., 1st sess., March 19, 1975, p. 201.

Licensing of Nuclear Materials

The first line of defense in the U.S. system for keeping nuclear materials out of the hands of people who should not have them is the statutory prohibition against possession or use of such materials except as licensed by the Nuclear Regulatory Commission. In addition, section 57(c) of the Atomic Energy Act of 1954 as amended specifies that the NRC shall not distribute any nuclear materials or issue a license for enriched uranium or plutonium to any person within the United States if the Commission finds that the distribution of such material or the issuance of such license would be inimical to the common defense and security or would constitute an unreasonable risk to the health and safety of the public. Based upon this statutory authority, the AEC and now the NRC have issued guides and regulations providing for safeguards measures to be followed by those persons licensed to have and to use nuclear materials.

Safeguards and Physical Security

The nuclear age has created new words and brought new meaning to old ones. The word "safeguards" is one that now and in the future must rank in importance with "fission" and "uranium". "Safeguards" refers to ways and means to assure prompt detection of attempted or actual theft or diversion of nuclear materials, and to reduce access to nuclear materials through use of barriers and containment. Recently "safeguards" as used in the United States has been expanded to include the use of guards and other measures of physical security to protect against armed robbery. Within the United States, holders of nuclear materials are responsible for their safeguarding under terms of licenses and regulations of the Nuclear Regulatory

Commission.* The NRC itself is well aware of the emphasis upon safeguards explicit in the language and legislative history of the Energy Reorganization Act of 1974, which took the regulatory functions of the old AEC and assigned them to the new NRC. According to NRC Commissioner Gilinsky, nuclear powerplants do not pose a serious problem of nuclear theft, and so NRC is placing special emphasis on the safeguarding of industrial plants that handle plutonium and highly enriched uranium and on safeguarding nuclear materials in transit. NRC is relying in part on enhanced physical security to compensate for deficiencies that it acknowledges in current nuclear materials accountability systems.** On the other hand, the NRC is still rather silent on controlling the risks of deliberate sabotage of nuclear powerplants and nuclear fuel facilities to cause a dangerous release of radioactive materials. The modern world of terror seems to be making a slow impression upon fundamental concepts of safeguards, a condition that causes some concern.

Safeguards systems in the United States include physical protection of facilities, material accountability systems to keep track of nuclear materials, and transportation security.

Physical protection at installations containing nuclear materials are specified by the NRC. During 1974 the Commission required new protective

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* Commissioner Gilinsky of the Nuclear Regulatory Commission uses the term "safeguarding" to mean those measures employed to protect nuclear materials against theft. Such protective measures include both physical protection, such as fences and guards, and measuring and accounting for nuclear materials. Cf. April-May hearings, p. 758.

** April-May hearings, p. 759.

measures at all 19 facilities licensed to hold four or more pounds of plutonium or 11 pounds of highly enriched uranium.* Each licensee is now required to:

(1) Maintain an armed on-site security organization;

(2) Protect nuclear materials by a system of two barriers, typically fences and walls, the outermost to be lighted and alarmed;

(3) Provide a system of rigorous facility access control;

(4) Provide a system of radio communication between guards and between the facility and a nearby local law enforcement agency; and

(5) Establish arrangement for quick response of local law enforcement agencies when needed.

Control and accounting for nuclear materials at licensed plants also have been recently revised and tightened by the NRC. Licensees are now required to maintain and follow written material control and accountability procedures to trace in detail the movements of the materials in their facility. The licensee must conduct bi-monthly inventories of plutonium and highly enriched uranium and maintain a record of each inventory discrepancy, or MUF (material unaccounted for.) The discrepancy is the difference between material expected to be present on the basis of records and the amount actually measured. These differences are expected to be less than 0.5 percent of the material passing through the plant between inventories.

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* Note that these amounts are lower than the minimum amounts needed for simple nuclear weapons.

Transportation of nuclear materials is also regulated by the NRC. The regulations, which were recently revised, apply to shipment by road, rail, air or sea. The NRC regulations require:

(1) suitable escort, or for air shipment, monitoring of loading and unloading of aircraft;

(2) improved communication between the escort or monitor and the licensee; and

(3) tracing any shipment that may fail to arrive and immediate notification of the NRC.

The increased safeguards requirements are, however, but one step toward the additional safeguard measures that will be required as the volume of nuclear materials grows in industry, as the technical complexities of nuclear facilities increase, and as the social and political environment changes. The NRC itself noted for us several opportunities to further strengthen safeguards by:*

(1) increased physical security through more effective devices, barriers, guards;

(2) tighter material accountability systems through more frequent and accurate inventories;

(3) installation of "real time" monitoring systems; and

(4) strengthened transportation security through more secure vehicles, better communications and guards.

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* April-May hearings, p. 760.

The NRC has underway three studies designed to investigate various aspects of the safeguards problems as well as to provide some potential solutions. These three include the study of a possible security agency within the NRC as required by Congress in the Energy Reorganization Act, a survey of nuclear energy center sites dealing with possible colocation of nuclear facilities to reduce risks and increase effectiveness of safeguards, and a special safeguards study.

The NRC acknowledges that all risks cannot be eliminated. So it opts for a graduated safeguards system as the most efficient approach, one which varies the intensity of the safeguards to the degree of risk of theft or diversion. NRC gives primary attention to nuclear materials during the period from when the fuel leaves an ERDA enrichment plant until it enters the reactor. Within a few years this attention will also have to include nuclear materials recovered at licensed commercial fuel reprocessing plants. At present none of the commercially built fuel reprocessing plants in the United States is operating, and it is unlikely that any one of them will be in full operation for some years to come.

Another factor is economics. Obviously the effectiveness of safeguards depends upon the time and effort assigned to them. But that time and effort costs money, and from the standpoint of power economics, safeguards costs are non-productive and serve only to increase the cost of nuclear power. So there is a continual basis for conflicting objectives, between the goal of maximum safeguards to protect the public and national safety, and the goal of minimum cost of electricity for the benefit of individual, corporate and other organizational users.

The Adequacy of Safeguards

Whether or not domestic safeguards can perform adequately is a matter of controversy in which the disputants have become polarized. The nuclear industry and the Nuclear Regulatory Commission, while agreeing that zero risk is not attainable, argue that the risk is slight in comparison with benefits of civil nuclear power at home and abroad and is endurable by our society. Environmentalist and other public interest groups advise that the potential consequences--death and destruction--from a successful, although improbable, theft or diversion are so terrible that society should not have to bear them and that the use of nuclear power therefore should be banned or drastically reduced. Advocates of this position expect that whatever energy and electrical supplies are lost through such action can be quickly offset by immediate large scale use of solar energy; by severe, government-enforced conservation of energy; by curtailed use of electricity; and by greatly increased use of coal. Advocates of a nuclear moratorium also believe that even if a safeguards system could be made sufficiently effective, the social cost of such a system, in terms of loss of civil liberties, is repugnant to the American tradition and is unacceptable. Proponents of commercial nuclear power see effective safeguards systems as no more onerous a burden to society than other systems now in use to protect information or facilities, or valuable commodities.

Since much of the previous discussion has presumed effective safeguards, it is appropriate here to recall some views of Natural Resources Defense Council which is one of the active critics of nuclear energy.

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Summing up the dilemma of nuclear energy and its opposition to a nuclear future, NRDC said:*

> These dilemmas raise the question of whether plutonium is simply too dangerous for commercial application. A basic question is whether we want to entrust so demanding and unrelenting a technology as plutonium-based nuclear power to human institutions which are negligent of their responsibilities and to technical fixes which are untried and unproven. Reasonable prudence dictates that we look elsewhere for our energy and to plutonium only as a last and desperate resort.

Concerning the impact on the U.S society, NRDC anticipated "tremendous distortions" in our values and social institutions would be required in an attempt to live with plutonium. "It may be that in attempting to do the impossible--to live with plutonium--we will create the intolerable."*

Concerning specific social repercussions, NRDC advised that:**

> First, the proliferation of nuclear reactors abroad will increasingly give rise to demands for international control and ownership of spent reactor fuels and, of course, the reprocessing of plutonium from those spent fuels. That private enterprise here or even government enterprise abroad will be prepared to turn over a major portion of the nuclear industry to international control is to be doubted, yet such a move is probably essential if nuclear expansion proceeds and a general proliferation of nuclear weapons is to be avoided.
>
> A second problem concerns the proposal now under NRC consideration to build gigantic nuclear parks each containing perhaps 40 large reactors and related fuel cycle facilities. What will the impacts of such parks be on smaller utilities and on the structure of ownership; and management in the utility industry? What are the potential political consequences of such mammoth concentrations of economic power?
>
> The most far-reaching of the social implications of plutonium, however, is the threat to civil liberties and privacy. Safeguards

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* Ibid., p. 786.

** Ibid., p. 788.

> necessarily involve a large expansion of police powers. Some one million persons have been trained in the handling, moving and operation of nuclear weapons. The projected growth of the nuclear industry would require a second and perhaps much larger group of persons--in this case civilians--who would be subjected to security clearances and other "precautions" which are commonplace in the military weapons program...
>
> Security and surveillance procedures at best infringe upon the privacy of employees, their families and friends. At worst, they are the instruments of repression and reprisal.
>
> * * * * * * * * * * * *
>
> Once the full safeguards security apparatus has been unleashed, there is no telling where the process might end. The drastic nature of the threat from nuclear terrorism will most likely evoke a drastic police response.

Summarizing its overall objections to nuclear power, to use of plutonium and to the implied safeguards required, the NRDC concluded:*

> The United States was the first nation to see the full meaning of modern technology and to exploit it. We should also be the first to see technology's limits. It is imperative that our society develop a capacity for saying no to technologies that are too risky and too demeaning. We can no longer assume that each new innovation accompanied by financial backing should be permitted to proceed, even with regulation. Some should simply be halted for the reason that their advantages bear no reasonable relationship to the possibility of tremendous social harm they present. The use of plutonium fuel falls clearly within this category. The nuclear future projected by its proponents ranks with world poverty, overpopulation and resource depletion as one of the principal threats to world stability and human survival.

While the other analysts do not view the nuclear future as darkly as does the NRDC and allied organizations, the points that they raise deserve consideration. Without doubt the commercial use of nuclear power and the control of its attendant risks from accident and theft or sabotage impose

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* Ibid.

great responsibilities upon human, and thus fallible, institutions. For this reason, observers hold that consideration should be given the doubts, reservations, and criticisms of concerned citizens and their organizations. Such consideraton is particularly important for ways and means to limit proliferation of nuclear weapons.

Government Responsibilities for Nuclear Safeguards

Many Federal, State and local government organizations are presently or may become involved with nuclear safeguards. The Nuclear Regulatory Commission, of course, is the lead agency for safeguarding of nuclear materials and facilities of licensees. Next comes the Energy Research and Development Administration, which is independently responsible for safeguards of nuclear materials and facilities in the hands of its operating contractors. So at the moment ERDA is responsible for safeguarding far more enriched uranium and plutonium than is the NRC. The NRC functions through licensing, promulgation of regulations and inspection for compliance with regulations. The ERDA functions by directing its contractors to take specified measures. ERDA and the State Department negotiate agreements with their safeguards provisions. NRC licenses export of nuclear materials and facilities while ERDA approves export of certain nuclear information and technology.

Looking beyond NRC and ERDA, the responsibilities for gathering intelligence about possible attempts at theft, diversion or sabotage are shared by Federal, State and local law enforcement agencies with no formally established means of coordination or cooperation. The repelling of an initial

overt attack or theft or sabotage is the responsibility of the licensee and the local law enforcement agency. The recovery of stolen materials rests with the Federal Bureau of Investigation assisted by Emergency Action and Coordination Teams of ERDA and the NRC.

These arrangements, which the Committee may examine in depth later, suggest that the many possible roads to proliferation are all unpatrolled and that human problems of local pride, bureaucratic isolationism and uncoordinated planning and action may leave embarrassing gaps or weaknesses in defenses against proliferation.

In addressing the adequacy of nuclear safeguards at the hearings, the National Resources Defense Council (NRDC) observed widespread agreement that current safeguards required by the NRC are inadequate and that the Commission had conceded this in its draft environmental statement of plutonium recycle: "Where there is substantial disagreement is whether an acceptable safeguard scheme can be devised and successfully implemented on the required scale and for long periods."* In the NRDC's judgment such a safeguards system cannot be achieved for several reasons:**

(1) Unprecedented and ultimately unworkable demands will be placed on those who operate the safeguards program which must be essentially infallible. NRDC noted that Dr. Alvin Weinberg's call for "unaccustomed vigilance" and "a continuing tradition of meticulous attention to detail" as implies unattainable conditions for effective safeguards. Accordingly, NRDC

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* April-May hearings, p. 785.

** Ibid., pp. 785-6.

argued that, because human institutions are far from infallible, losses of nuclear materials cannot be prevented.

(2) U.S. experience with present safeguarding procedures is hardly reassuring. NRDC cites the example of major discrepancies in inventory accounts and possible losses of weapons grades materials by an AEC contractor and a GAO report on inadequate physical security at other AEC contractors.

(3) Safeguards measures proposed by NRC have been opposed by the nuclear industry, so much so that industry's response is likely to be inadequate.

V. GOVERNMENT CONTROL OF NUCLEAR EXPORTS

The exports of certain information, and technology, materials, components and facilities for nuclear power are subject to a variety of licenses and authorizations by three different Federal departments or agencies, two of them directly controlled by the President and one nominally independent of that control. Dr. Scoville characterized the present U.S. nuclear export policies and organizations as in a state of turmoil. For him, the dissolution of the AEC, the transfer of its regulatory functions to the Nuclear Regulatory Commission, and the transfer of its other activities to the Energy Research and Development Administration have fractionated responsibilities for controlling nuclear exports. This splitting of responsibilities has led to delays in authorizing exports and to uncertainties as to where the basic responsibilities may lie in a specific case.* He proposes greater centralization of responsibility within the executive branch and more efficient utilization of the expertise of ERDA, together with sufficient checks and balances to avoid sacrificing non-proliferation objectives to industrial or foreign policy pressures. Tighter congressional controls over agreements for cooperation would also help check against possible overenthusiasm by the executive branch.**

It should be noted that Congress is giving attention to the division of responsibilities for control of exports for nuclear power technology as well

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* Cf., statement of Herbert Scoville in July hearings, p. 101.

** Ibid., p. 101

as for materials and facilities. Proposals now before Congress would further modify respective functions of ERDA, NRC and the Department of Commerce for nuclear exports.* There follows a brief discussion of controls over nuclear exports, and recently proposed legislation.

Commercial Transactions

In the U.S. economic system, exports of nuclear powerplants, major components and technology for such plants and fabricated nuclear fuel are made mainly by private companies. Direct Federal action is limited largely to exporting enriched uranium, or providing enrichment services to foreign customers who then may export the enriched uranium directly or indirectly in U.S fabricated nuclear fuel elements. The commercial exports are made within the framework of U.S. agreements for cooperation which the Department of State and the Energy Research and Development Administration negotiate with foreign governments. The authority for these agreements is Section 123 of the Atomic Energy Act of 1954. U.S. companies can also export technology by supplying information and reports, by licensing arrangements, or by joint ventures or through foreign subsidiaries. It is a U.S nuclear company, not ERDA or NRC, that signs a contract with a foreign counterpart, or a foreign utility, or some foreign government organization. Within the terms of export licenses or other approvals, it is the responsibility of the private company to perform, not of the Government.

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* The Senate Committee on Government Operations has before it S. 1439, the Export Reorganization Act of 1976.

NRC Export Licenses

Commercial organizations wishing to trade in export materials and facilities to a country with an agreement for cooperation must apply to the Nuclear Regulatory Commission for an export license. The NRC in turn asks the executive branch through the Department of State to provide information to assist it in a determination of whether issuance of the license is consistent with U.S. national security interests. After review and consultation with other agencies, the State Department provides NRC with the collective recommendations of the executive branch on the issuance of the license.

The information provided in the State Department review falls into two categories. The first is technical data relating to safeguards in the recipient country. The second is information of a more general policy nature, bearing on the effect of the export on U.S. objectives regarding the spread of nuclear weapons. The first category includes information relating to the terms of the agreement for cooperation between the United States and the government of the recipient; the acceptance and implementation by the recipient country of IAEA safeguards and/or other appropriate bilateral understandings; and the practices of the recipient's government with respect to physical security of nuclear materials and facilities. The second category of information includes the executive branch's assessment of the recipient country's policy with regard to proliferation; and any other information and evaluations bearing on the proposed license.*

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* Cf., statement of NRC Commissioner Gilinsky, July hearings, p. 49.

According to NRC Commissioner Gilinsky, this implementation of NRC's export licensing authority under the Energy Reorganization Act of 1974 has resulted in a sound decisionmaking process which brings to the Commission for final action an integrated, balanced evaluation of the various ingredients necessary to prudent nuclear export decisions. The importance of integrating Government action on nuclear exports in order to support a coherent overall U.S. antiproliferation policy, he stressed, cannot be overemphasized. He opposed proposals to reallocate export licensing responsibilities, saying:*

> In my view, the present system is essentially sound, and should be given an adequate trial before legislative adjustments are considered. I believe we have achieved a good measure of control over nuclear material and facility exports, although admittedly there may still be facets of the nuclear export licensing process which need some attention and thought.

Not all nuclear exports, however, require NRC licenses. As Commissioner Gilinsky pointed out, government to government transfers of nuclear materials or facilities are exempt. ERDA is responsible for such sales, grants or leases.**

At this point there is a potential problem. The NRC approval of the export license can be viewed in different ways. One is that the NRC simply performs a strictly ministerial function and issues the license when the forms are complete and are backed by a file of analysis and advice from the executive branch. The issuing of dog and drivers' licenses is a typical

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* July hearings, p. 49.

** Ibid., p. 50.

ministerial function. The other is that the NRC itself will make its own independent determination. Commissioner Gilinsky supports the latter view. One factor influencing the future of NRC export licensing is its ability to recruit and organize a staff able to make sober and reliable assessments. On one hand, NRC does not want to become a rubber stamp for the State Department or ERDA. On the other hand, it would avoid bureaucratic delay, negative response or avoidance of controversial decisions. The situation is further complicated because the Administration has chosen to promise U.S. nuclear aid and products to various countries as a carrot to gain their cooperation with U.S. foreign policy. For example, commitment by the President to sell nuclear power reactors to Egypt or to Iran or to Israel could produce White House pressures on the NRC to approve the required licenses without argument or delay. How well the NRC could stand up to such pressure is a matter of concern. Some Members of Congress believe that the control of proliferation is important enough to require an independent check upon the President by the NRC. The trend over recent years to view independent regulatory agencies, including the NRC, as organs to carry out a President's economic and other programs and to expose these agencies to influence of the President through his powers of appointment and removal of key officials and his control over the budgets and appropriations can run counter to this congressional intent. At issue is how much the NRC should be insulated and protected from direct or indirect pressures of the executive branch when it is deciding what to do about a potentially controversial export license request.

The first year of NRC's safeguards history is notable because of its decision of March 1974 to limit the issuance of export licenses pending the completion of a review of the regulations and procedures followed by NRC and other Government agencies for the licensing of exports. During the following review period, the NRC Commissioners personally reviewed all export license applications involving reactors or significant quantities of nuclear materials. The announcement generated so much furor that the NRC a few weeks later issued another statement to note and correct what it saw as misapprehensions. It said in part:*

> The Nuclear Regulatory Commission has noted several recent stories carried in the press in the United States and abroad which have stated or implied that the NRC has placed a ban on exports of nuclear materials. The thrust of these stories has been that nuclear fuel needed for power and research reactors abroad, the supply of which the U.S. had earlier agreed to assure, has been cut off. The NRC categorically stated today that there has been no ban placed upon such shipments by the NRC.

This incident is a notable illustration of how sensitive a subject the licensing of nuclear exports can be.

Department of Commerce Export Licenses

Under the regime of the Atomic Energy Commission, the AEC divided its control over nuclear exports with the Department of Commerce, an arrangement which has been continued by the Nuclear Regulatory Commission. Under this arrangement, the Department of Commerce licenses exports of nuclear facility components. Although the Atomic Energy Act of 1954 permits the NRC to make a determination to license export of principal

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* NRC press release no. 75-90, April 15, 1975.

components of facilities, this authority has never been exercised. The Commerce Department also licenses export of heavy water and other items potentially useful in foreign nuclear programs. The Department obtains advice from the Energy Research and Development Administration, not from NRC, on the export of such items. In addition, the Department of Commerce will not license export of items on a list of critical exports that has been compiled by the international coordinating committee on export policy toward communist countries, COCOM, on which are represented most NATO states plus Japan. The purpose of this committee is to embargo the export of strategic items to Sino-Soviet bloc countries. There are many atomic energy related items on the COCOM list. ERDA, not NRC, participates in the development and updating of these lists.

ERDA Approval of Technology Exports

The export of physical objects--nuclear materials and equipment--is controlled by the Nuclear Regulatory Commission and the Department of Commerce. However, the control of exports of intangible information and technology remains in the hands of the Energy Research and Development Administration under the Energy Reorganization Act of 1974. ERDA is well aware of this residual responsibility and recently reissued regulations governing such exports, which it does indirectly by regulating certain activities by Americans, as individuals or companies, in foreign atomic energy programs.* The basis for this continuing ERDA function is section

* Unclassified activities in foreign atomic energy programs. 10CFR 810. Federal Register, vol. 40, Sept. 30, 1975: 44826-44828; and Oct. 30, 1975: 50457.

57.b(2) of the Atomic Energy Act of 1954 as amended.* These NRC regulations begin with a general authorization of activities which do not require specific case by case authorization. Activities which require specific authorization include the following:

> (i) Designing or assisting in the design of facilities for the chemical processing of irradiated special nuclear material, facilities for the produciton of heavy water, facilities for the separation of isotopes of uranium, or equipment or components especially designed for any of the foregoing; or
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> (ii) Constructing, fabricating, or operating such facilities; or
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> (iii) Constructing, fabricating, or furnishing equipment, or components especially designed for use in such facilities; or
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> (iv) Training foreign personnel in the design, construction, fabrication, or operation of such facilities or equipment or components especially designed therefore; or
>
> (v) Furnishing information not available to the public in published for for use in the design, construction, fabrication, or operation of such facilities or equipment or components especially designed therefore.

In addition, ERDA has determined, in a blanket regulation, that activities not generally authorized which constitute directly or indirectly engaging in the production of any special nuclear material outside of the United States will not be inimical to the interest of the United States and are authorized provided that they:

> (1) Do not involve the communication of Restricted Data or other classified defense information; and

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* Section 57.2(b) makes it unlawful for any person to directly or indirectly engage in the production of any special nuclear material outside of the United States except (1) under an agreement for cooperation made pursuant to section 123, or (2) upon authorization by the Commission after a determination that such activity will not be inimical to the interest of the United States.

(2) are not in violation of other provisions of law; and either,

(3) are limited to participation in (i) meetings of conferences sponsored by educational institutions, laboratories, scientific or technical organizations; (ii) international conferences held under the auspices of a nation or group of nations; or (iii) exchange programs approved by the Department of State; or

(4) are limited to furnishing of information which is available to the public in published form or which will be made available to the public in published form within 60 days after the furnishing thereof.

The ERDA regulations specify that the Administrator will approve an application for a specific authorization to engage directly or indirectly in the production of special nuclear materials outside of the United States if, after taking into account several factors, he determines that the activity will not be "inimical to the interest of the United States."*

If the Administrator grants such an authorization, he may later revoke, suspend or modify the authorization in whole or in part if he finds that the conduct of any or all of the authorized activities would be inimical to the interests of the United States.

Administration of this approval function by ERDA is worth attention because, unlike nuclear materials or facilities or components, nuclear

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* The factors to be taken into account include: (1) whether the United States has an agreement for cooperation with the country in which the proposed activity will be conducted; (2) whether the country in which the proposed activity will be conducted is a party to the treaty on the Non-Proliferation of Nuclear Weapons (NPT) and, pursuant thereto, has entered into a agreement with the International Atomic Energy Agency (IAEA) for the application of safeguards to its peaceful nuclear activities; (3) whether the country in which the proposed activity will be conducted, if not a party to the NPT, will accept IAEA safeguards with respect to the project; (4) the relative significance of the proposed activity and availability of comparable assistance from other sources; and (5) any other fact which may bear upon the political, economic, or security interests of the United States.

technology and information are intangible, vague and difficult to define and to delimit with precision.

On the whole, there is the possibility for divergent and incompatible actions between NRC and ERDA. Since ERDA is under direct Presidential control, it is conceivable that for a given major export program important to U.S. foreign policy, ERDA might approve export of technology while NRC might question or even decide not to license the export of the related materials and equipment involved.

Legislation Affecting Nuclear Exports

The proposal of President Nixon in 1974 to provide both Egypt and Israel with substantial assistance in nuclear power, including nuclear powerplants, the attempts of South Korea and Pakistan to import fuel reprocessing capability, and the efforts of Iran and Brazil to acquire self-sufficient nuclear power industries have generated substantial congressional interest in ways to further limit future nuclear proliferation. Table II lists bills that were proposed to this end during 1975. Of these, S. Res. 221 was approved by the Senate on December 12, 1975. Central concepts of these bills included reorganization of nuclear export licensing, a moratorium on export licenses, congressional approval of transfers, a prohibition of transfers to non-NPT states, limitation upon Export-Import Bank financing of nuclear exports to non-NPT nations, support for stronger international export controls and safeguards, and a proposal for an OTA study of safeguards. A description of S. Res. 221 and brief discussion of other concepts follow.

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Table II

BILLS AND RESOLUTIONS ON EXPORT CONTROLS AND SAFEGUARDS FOR NUCLEAR TECHNOLOGY

Bills to Strengthen Control of Exports of Peaceful Nuclear Technology

S. 1439 - (Percy) 4/15/75. Government Operations
A bill to reorganize and centralize the export licensing functions of the Federal Government for nuclear materials, technology, or facilities, and improve international safeguards procedures.

4/24, 4/30, 5/1/75 - Hearings

S. 1826 - (Gravel) 5/22/75. Atomic Energy
The Nuclear Power Reappraisal Act--A bill to suspend the licensing of nuclear powerplant construction and exports pending a five-year comprehensive study by the Office of Technology Assessment of the nuclear fuel cycle.

No action

S. 2329 - (Stevenson) 9/10/75. Banking, Housing and Urban Affairs
A bill to amend the Export-Import Bank Act to limit financing for sales of nuclear materials and technology to state not a party to the NPT.

No action

H.R. 622 - (Long, Md.) 1/14/75. Atomic Energy
A bill to prohibit the transfer of nuclear materials to countries which have not ratified the NPT.

No action

H.R. 6082 - (H.R. 7223, 7224) - (Diggs) 4/16/75. Atomic Energy
A bill to prohibit the transfer of nuclear materials to countries which have not ratified the NPT.

No action

S. Con. Res. 69 - (Cranston) 10/9/75. Atomic Energy
A bill to urge, in part, a halt on further transfers--exports--of nuclear technology to countries not accepting IAEA safeguards or not joining the NPT, and to urge agreement among suppliers to reprocess plutonium in secure regional centers.

No action

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H.R. 8282 (8297, 8685) - (Biaggi) 6/26/75. Atomic Energy
A bill to prevent the proliferation of nuclear weapons by limiting the transfer of certain nuclear technology and materials.

No action

H.R. 8342 - (Long, Md.) 6/26/75. Atomic Energy
A bill to prevent the proliferation of nuclear weapons by limiting the transfer of certain materials.

No action

Resolutions to Control Peaceful Nuclear Exports and Strengthen Safeguards

S. Res. 188 (S.R. 199) - (Mondale) 6/18/75. Atomic Energy
A resolution urging the President to seek an immediate international moratorium on the transfer to non-nuclear weapon countries of nuclear enrichment and reprocessing equipment and technology.

No action

S. Res. 221 - (Pastore) 7/26/75. Foreign Relations
A resolution relating to international cooperation in strengthening safeguards of nuclear materials

No action

H. Res. 609 - (Ottinger) 7/18/75. International Relations
A resolution urging the President to seek agreement among the nations supplying nuclear equipment and technology not to transfer it to non-NPT nations.

No action

H. Con. Res. 371 - (Zablocki) 7/30/75. International Relations
A resolution to declare, in part, the desire of Congress to halt any further transfers of nuclear fuel, technology and equipment to any country which has not accepted IAEA safeguards for all of its nuclear activities or has not become a party to the NPT, if all other major suppliers agree to a similar halt of such transfers.

A Bill Requiring an Office of Technology Assessment Study of Plutonium Safeguards

S. 1197 - (Tunney) 3/17/75. Atomic Energy
H.R. 3618 - (H.R. 4945, H.R. 6394) - (Aspin) 2/25/75. Atomic Energy
The Plutonium Recovery Control Act--Contains a section requiring OTA to investigate the risks of unauthorized diversion of plutonium.

No action

S. Res. 221.--On July 26, 1975, Senator Pastore introduced Senate Resolution 221.* Its purpose was to convey the sense of the Senate that the President should:

(1) Seek immediate international consideration of strengthening the effectiveness of the safeguards of the International Atomic Energy Agency and intensified cooperation of nuclear supplier nations to insure that the most stringent safeguards are applied to the transfer of nuclear equipment and technology;

(2) Seek an intensive cooperative international effort to strengthen and improve the scope, comprehensiveness and effectiveness of the international safeguards on peaceful nuclear activities so that there will be a substantial and immediate reduction in the risk of diversion; or theft of plutonium and other special nuclear materials to military or other uses that would jeopardize world peace and security; and

(3) Seek restraint by nuclear supplier nations in their exports of nuclear technology, and their cooperation in assuring that such equipment and technology only is transferred to other nations under the most rigorous, prudent and safeguarded conditions designed to assure that the technology itself is not employed for the production of nuclear explosives.**

The resolution passed the Senate on December 12, 1975.

Reorganization of nuclear export licensing.--The concept of reorganizing and centralizing the export licensing functions of the Federal Government

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* For himself and for Senators Mondale, Inouye and Montoya.

** Cf., U. S. Congress. Senate. International Safeguards of Nuclear Materials. Sen. Rept. No. 94-525, Dec. 10, 1975, pp. 1,2.

for nuclear materials, technology and facilities is embodied in S. 1439. The bill's sponsors believe that centralization of the Federal Government export functions for nuclear materials would improve the decision-making and permit closer oversight for such exports.

The latest version of S. 1439, dated January 8, 1976, would make five functional changes, expand congressional participation, make four procedural changes and require two studies for Congress. The bill would make the following functional changes:

(1) Consolidate licensing for all peaceful nuclear exports in the NRC. These export control functions would include those now exercised by ERDA and the Department of Commerce for technology and components.

(2) Transfer to the NRC the functions of the Transportation Department relating to the transportation of radioactive materials.

(3) Designate the State Department as the lead agency for negotiating, renegotiating and administering agreements for nuclear cooperation, with close cooperation and technical assistance of ERDA.

(4) Require the Arms Control and Disarmament Agency to prepare and submit Nuclear Proliferation Assessment Statements to the NRC, State Department and Congress for all U.S. nuclear agreements and subsequent agreements with other countries and for all strategically significant nuclear-export license applications.

(5) Require ERDA to establish a safeguards training program for nations receiving peaceful nuclear assistance from the United States.

(6) Expand congressional participation. Under the Atomic Energy Act of 1954 as amended, agreements for nuclear cooperation after they have been approved by the President must lie before Congress for specified numbers of days. For the more sensitive agreements, the Joint Committee on Atomic Energy must report its views and recommendations to Congress, together with an accompanying proposed concurrent resolution stating whether or not Congress favors the proposed agreement. If Congress passes a resolution stating that it does not favor an agreement, the agreement cannot become effective.*

S. 1439 would provide a substantial new function for Congress for certain nuclear export licenses. It would permit the NRC to submit to Congress the final determination on approving a nuclear export application that raises substantial foreign policy considerations that the NRC cannot adequately resolve.

S. 1439 as revised would mandate the following procedural changes for licensing of nuclear exports:

(1) Require the State Department to take into full consideration the recommendations and policies of the NRC concerning the licensing and authorization of exports, before negotiating or renegotiating nuclear agreements and subsequent arrangements under these agreements.

(2) Require the State Department to furnish NRC with all executive branch data and recommendations that are required by the NRC to make its nuclear export licensing decisions.

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* Section 123(d) of the Atomic Energy Act of 1954 as amended.

(3) Require the NRC to take into account the adequacy of safeguards in the recipient country against nuclear diversion, theft or sabotage. This consideration would be part of the NRC's statutory determination whether a nuclear export would be inimical to the common defense and security and public health and safety of the United States.

The bill would require two studies for Congress:

(1) A study of the feasibility of internationalizing all strategically significant parts of the nuclear fuel cycle, to be done by the State Department with assistance from ERDA; and

(2) A study of the differences and interactions between nuclear safeguards as applied by the United States and the International Atomic Energy Agency, to be done by the NRC.

A five-year moratorium on export licenses for nuclear powerplants.--The proposed Nuclear Power Reappraisal Act of 1975, S. 1826, would require the NRC both to cease granting licenses for the export of nuclear fission powerplants and to cease granting licenses for the construction of domestic nuclear powerplants. During a five-year licensing moratorium the Office of Technology Assessment would undertake a comprehensive study of the nuclear fuel cycle with particular emphasis on the potential consequences of the proliferation of nuclear fission powerplants in the United States and elsewhere. The resumption of the licensing of domestic construction, and the export of nuclear powerplants would be dependent upon a congressional determination that the nuclear fuel cycle poses no extraordinary threat to public health and safety and is economically viable, and passage of legislation to authorize resumption of export and construction licensing.

Prohibition of nuclear exports without congressional approval.--H.R. 622 would prohibit the transfer of atomic technology to foreign powers without the express approval of Congress. This proposal builds upon the work of the 93d Congress in expanding the congressional power to disapprove of international nuclear cooperation agreements. (Public Law 93-485.)

Prohibition of the transfer of nuclear materials to non-NPT nations.--The ratification of the Non-Proliferation Treaty as a condition for export of nuclear materials to a given country is embodied in several of the nuclear export control bills introduced in the 94th Congress. This criteria probably reflects one or both of the following: an endorsement of the value of the NPT and the ability of its safeguards requirements to check nuclear proliferation; and a means of pushing non-NPT nations to sign the treaty in return for access to U.S. nuclear technology, materials, and financing.

H. R. 6082 and its identical bill H. R. 7223 would prohibit the sale, shipment, transfer, or exchange, direct or indirect, of enriched uranium, plutonium, any source of special fissionable material, equipment for processing, use or production of source or special fissionable material, and scientific or technical information to any country which has not ratified the NPT. The only exceptions would be in cases where the President determines that the sale, shipment, transfer, or exchange is essential to the national security of the United States and reports this determination to Congress, and Congress by concurrent resolution, approves the sale, shipment, transfer or exchange.

The language in H.R. 6082 indicates that its authors were concerned that its restrictions apply to the export and re-export of U.S.: technology,

knowledge, equipment, materials and other items used at all stages of the nuclear fuel cycle. In providing for exceptions to this law, the authors have required that Congress expressly approve of the proposed transfer of nuclear materials, technology, etc.

H. R. 8282, and its identical bills, expands on the notion of limiting peaceful nuclear exports to nations which have ratified the NPT by allowing the conclusion of a safeguards agreement with the IAEA or Euratom as a substitute for NPT ratification. These bills would prohibit the NRC from licensing or authorizing the export, or ERDA from engaging to allow the export, of nuclear fuel or nuclear technology to any country which:

--is not a party to the NPT and which develops either an enrichment or reprocessing plant without concluding an agreement with the IAEA or Euratom (which are parties) by which all its present and future nuclear facilities are made subject to safeguards established by either agency against diversion of nuclear material, or

--furnishes or agrees to furnish uranium enrichment or nuclear fuel reprocessing plants to countries not party to the NPT.

These prohibitions would be waived if the President determines that the national security interests of the U.S. would best be served by the issuance of such license or authorization and provides this written determination to Congress at least 90 days prior to the issuance of such license or authorization.

H.R. 8342 is identical to H.R. 8282 except that it would require the Presidential determination of national security interest to lie before Congress for sixty rather than ninety days.

These bills focus on a specific type of importing country, one which is a potential supplier of nuclear enrichment and reprocessing equipment. U.S. concern about this aspect of the nuclear fuel cycle is due to the fact that reprocessing equipment is vital to the extraction of plutonium from spent nuclear reactor fuel, and plutonium is an essential ingredient of nuclear explosives. Highly enriched materials are also essential to bomb manufacture.

Two similar bills to further reduce the risk of proliferation by limiting nuclear nuclear exports to nations which will accept IAEA safeguards for all their nuclear activities by and providing pressure on other states to become party to the NPT are H. Con. Res. 371 and S. Con. Res. 69. The former was the subject of hearings by the House Committee on International Relations in November 1975; the latter was discussed at length by Senator Cranston when he introduced it on October 9, 1975.* Both bills express congressional support for a halt on further transfers of nuclear fuel, technology and equipment to any country which has not accepted International Atomic Energy Agency safeguards on all of its nuclear programs, or which by January 1976 has not become a party to the NPT if all other major nuclear suppliers agree to a similar halt on such transfers. Second, the bills urge an international agreement providing that with respect to any plutonium for peaceful uses resulting from any transfer between countries of nuclear fuel, technology, or equipment, all processing of such plutonium (from its extraction from spent reactor fuel elements through its processing,

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* Cf., Congressional Record, October 9, 1975, pp. S18098-18102.

storage and final fabrication into new fuel elements and their installation into nuclear reactors) will be performed in regional facilities which are heavily protected and guarded under the strictest possible multinational safeguards. In addition, the Senate bill would urge a halt to the production of weapons grade material for weapons under an adequate verification system. Following the implementation of this provision, Congress would further urge the sharing of access to and the product of nuclear enrichment facilities of major nuclear powers with all nations who sign the NPT and accept IAEA safeguards.

Limit Export-Import Bank financing of nuclear exports to non-NPT nations.--Export-Import Bank loans have been used to finance purchases by other nations of U. S. nuclear materials and technology. S. 2329 would amend the Export-Import Bank Act of 1945 by adding the requirement that "no loan, guarantee, or other assistance shall be approved by the Bank's Board of Directors for the export of goods, technology, or services involving or relating to nuclear energy production or research in any country which is not a party to the NPT." This requirement would be waived if the President finds that the specific transaction is essential to the national security interests of the U.S. and reports such finding to the Congress at least twenty-five days prior to the date of final approval. Further, no loan, guarantee, or other assistance would be approved by the Bank's Board of Directors for the export of goods, technology, or services relating to nuclear energy or research unless the Bank has informed the Director of the U.S. Arms Control and Disarmament Agency thereof at least fifty days prior to the date of final approval.

This bill represents another affirmation of the value of the NPT and its safeguards provisions, and another means of encouraging nations to sign the NPT.

Resolutions supporting stronger international nuclear export controls and safeguards.--Several resolutions introduced in the Senate and House would urge the President to seek either restraint or a temporary moratorium on the transfer of nuclear technology internationally to provide time to negotiate improved international safeguards. Concern for controlling the export of enrichment and reprocessing equipment and technology, and prohibiting exports of nuclear equipment and technology to non-NPT nations also appears in these bills.

S. Res. 188 and S. Res. 199 would urge the President to seek an immediate international moratorium on the transfer to non-nuclear weapons countries of nuclear enrichment and reprocessing equipment and technology to permit time for the negotiations of more effective safeguards against the proliferation of nuclear weapons capability.

H. Res. 609 would express the sense of the House of Representatives that the President should seek agreement from other nations capable of supplying nuclear technology not to transfer such technology to nations which have not ratified the NPT. It would direct the President to urge supplier nations to suspend the transfer of nuclear enrichment and reprocessing facilities and technology to allow time for the negotiation of an agreement to reduce the risk of diversion or theft of nuclear materials.

Requiring the OTA to study safeguards measures for plutonium.--The proposed Plutonium Recovery Control Act of 1975, S. 1197 and H.R. 3618,

would prohibit the licensing of certain activities regarding plutonium until expressly authorized by Congress, and provide for a comprehensive study of plutonium recycling. As part of this comprehensive study the Office of Technology Assessment would investigate: the risks of the unauthorized diversion or theft of plutonium and the fabrication and use of unauthorized nuclear devices made from it; and the safeguards measures needed to minimize the unauthorized diversion or use of plutonium.

VI. THE INTERNATIONAL FRAMEWORK FOR LIMITING PROLIFERATION

Technical assistance and the export of nuclear materials, equipment and facilities contribute both to the further expansion of civilian nuclear power and to the potential proliferation of nuclear weapons. This assistance and export takes place within a framework of treaties, international organizations, bilateral and multilateral agreements between countries, and informal agreements. The dimensions and details of the framework have been formed not so much by consideration of what is most required to minimize further proliferation, but by consideration of what it was possible to erect within limitations of international rivalries and domestic politics. So it is not surprising that the framework has limitations. The very existence of the framework marks a notable achievement of innovation in diplomacy and foreign policy. Nevertheless, the framework may not now be capable of supporting stronger or additional measures to slow the future spread of the potential ability to make atom bombs, according to witnesses.

The principal documents that comprise the framework include international agreements, sales contracts, export licenses and export authorizations. Table III shows the nature and parties to these documents. The variety of these documents, their purpose and the parties to them form a complex picture that requires careful attention to understand. That understanding, however, is necessary for anyone who would address the adequacy of the international framework to limit further proliferation of nuclear weapons.

The purpose of this chapter is to describe the principle parts and features of the framework and identify some major related issues.

Table III

BASIC DOCUMENTS FOR NUCLEAR EXPORTS AND THEIR CONTROL

Document	Coverage	Parties
International Agreement	Umbrella	The U.S. and foreign governments
Sales Contract		
1. Enrichment services	Specific Transaction	ERDA and foreign client (company or government)
2. Other products	Specific Transaction	U.S. company and foreign client (company or government)
3. Technology	Specific Transaction	U.S. company and foreign client (company or government)
Export license for Nuclear Materials, Equipment	Specific Transaction	U.S. Nuclear Regulatory Commission and exporter for major orders, or Dept. of Commerce for minor orders
Export Authorization for Technology	Specific Transaction	ERDA and the exporter

The World Nuclear Market

The more any technology is used, the more likely it is to spread throughout the world. Nuclear power is no exception, and a growing world use of nuclear energy generates an increasing demand for nuclear materials,

equipment and facilities in the world market. This growth may help the energy problems of importing countries and increase high value exports for supplier countries. However, this anticipated growth will escalate the challenge of proliferation.

World use of nuclear power is expected to increase rapidly during the next two decades. Early in 1975 the International Atomic Energy Agency forecast that the number of nuclear powerplants throughout the world would increase from 200 in 1975 to 800 by 1985, with substantial increases also in the number of supporting facilities in the nuclear fuel cycles, as shown in Table IV. A world nuclear capacity of some 700,000 megawatts by 1985 would produce a cumulative 700 metric tons of plutonium by 1985 in thermal and fast reactors, with somewhat more than 500 metric tons of that amount contained in the reactors and the rest either recovered or in used nuclear fuel.*

The nuclear industry's estimate of the world nuclear market produces more optimistic figures. According to testimony, some 102 nuclear power stations representing 29,000 megawatts are licensed to operate outside the United States today and another 324 are either under construction, on order, or planned. This compares with 55 nuclear powerplants licensed to operate in the United States, representing 37,000 megawatts of generating capacity, with another 179 new plants expected for the future.**

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* International Atomic Energy Agency Bulletin, vol. 17, April 1975, pp. 7-9.

** Cf., statement of A.L. Bethel, Westinghouse Electric Corp., in July hearings, p. 62.

Table IV

PROJECTED FACILITIES IN THE WORLD NUCLEAR FUEL CYCLE

Type of Facility	1975	1977	1980	1985
Power Reactors	200	280	420	800
Uranium Fuel Fabrication Plants	24	28	36	55
Uranium and Plutonium Mixed Oxide Fuel Fabrication Plants	21	23	26	30
Irradiated Fuel Reprocessing Plants	6	8	12	17
Enrichment Facilities	8	9	10	13

Source: International Atomic Energy Agency Bulletin, April 1975, p. 9.

The forecasts of a growing international nuclear trade have caused a concern in some public organizations about further proliferation of nuclear weapons. NRC Commissioner Gilinsky pointed out that the number of nations with active civilian nuclear power programs or definite plans for such programs is continually increasing, with a consequent increase in international transactions in nuclear materials and technology. More than half a dozen nations are now acting as nuclear exporters and the pace of world nuclear trade has been quickened by recent increases in world oil prices.* During the 1950s and well into the 1960s, the United States was the dominant supplier of nuclear materials, equipment and facilities on the world market.

* July hearings, p. 47.

Now, as ERDA points out, the United States is only one of many suppliers and can no longer unilaterally inhibit proliferation by controls on its exports.*

The U.S nuclear industry is well aware of and is deeply involved in the day-to-day competition with companies from West Germany, France and Canada. It is clear that this competition for overseas sales is severe and is expected to become even more intense as the production capacity of the supplier countries expands. The U.S companies in this competition have to comply with regulations of the Federal Government and are concerned that some competing overseas suppliers may be less restricted by their governments.**

At the time of the Subcommittee's hearings, there were twelve projects in six countries on which at least one U.S. power reactor vendor had submitted bids. These projects were in Austria, Egypt, Spain, South Africa, Sweden, and Switzerland. Additionally, bids from U.S. suppliers had been invited by Israel, and Iran had held serious discussions with U.S. firms concerning nuclear powerplants to supplement those to be built by France and Germany. Countries planning to further expand their nuclear power include Korea, Spain and Switzerland. Greece is planning its first project and Denmark and Ireland are exploring possibilities for nuclear power.***

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* Cf., statement of Dr. A. Friedman, ERDA, Ibid., p. 33.

** Cf., statement of A.L Bethel, Westinghouse Electric Corp., Ibid., p. 64.

*** Information supplied to the Subcommittee by A. Friedman, ERDA. Cf., July hearings, p. 40

That there is an expanding world market for nuclear technology and its products does not mean the future structure of the world's nuclear industry is now firm. While large and politically irreversible commitments to nuclear power have been made in many countries, the basic pattern of the structure for worldwide development of the essential nuclear fuel cycle support facilities--uranium enrichment, irradiated fuel reprocessing and nuclear fuel fabrication--remains to be worked out. The pattern that evolves will be critical for future prospects for proliferation of nuclear weapons and the ability to make them.

Professor Willrich analyzed the possible patterns for growth of the world nuclear industry. For him, the most desirable pattern would be one of interdependence of national nuclear industries rather than a pattern of national nuclear independence. In his analysis, the trend will be towards nuclear interdependence if national governments make their decisions on the basis of economic efficiency and international security.* These considerations should lead to world nuclear growth determined by economic circumstances of individual nations and characterized by a national spread of nuclear powerplants, but not of key nuclear fuel cycle facilities.

Economic criteria would probably dictate a few large regional facilities to supply enrichment, reprocessing and fuel fabrication services. Ideally, these installations would be owned and operated by multinational organizations subject to inspection and audit by the International Atomic Energy

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* April-May hearings, pp. 751-2.

Agency. This path of development would not appear provocative among nations. As a fringe benefit, it might even lead to international review for safety of design and plans for nuclear powerplants and other facilities.

A less desirable but also plausible future evolution of the world's nuclear industries would occur if national governments assign higher priority to nuclear power independence than to economics. Each nation then would seek to acquire full fuel cycle capabilities as rapidly as possible in which to produce enriched uranium, to reprocess used fuels, and to fabricate fresh nuclear fuels. In most circumstances these facilities would not be economically efficient, but they could provide the nation concerned with part or all of its nuclear requirements. However, nuclear power independence, with its attendant capability to produce nuclear materials for weapons, would be viewed by neighboring countries as a threat to their security, thus turning them toward nationalistic development despite economic penalties. Furthermore, if nuclear power develops along nationalistic lines, large quantities of fuel materials in various forms would become widely dispersed in many countries and the problems of preventing national diversion or terrorist theft would become much more difficult, perhaps impossible to manage.

Which pattern of world nuclear power development will prevail? For Professor Willrich, it is not clear. Tendencies toward nuclear power development along primarily nationalistic lines are to be expected in many countries unless countered and offset. These tendencies are not yet irreversible, unlike the basic trend toward nuclear power. However, to reverse the trend towards nuclear nationalism will require strong and concerted governmental action within a few years.

International Agreements for Cooperation

The principal document governing U.S. export of nuclear information, materials, equipment and facilities is the agreement for cooperation. It is within the terms of these agreements that American nuclear companies write export contracts and the Nuclear Regulatory Commission issues export licenses. There follows a brief historical review of the origins and evolution of these agreements, their negotiation, contents, and current status.

Background.--One initial congressional response to the advent of nuclear weapons in 1946 was to severely limit export or exchange of nuclear information and technology. While the Atomic Energy Act of 1946 did provide for the sharing with other countries of information concerning the practical industrial applications of atomic energy, this could not be done until "effective and enforceable safeguards against its use for destructive purposes [could] be devised." With the failure of the U.S. proposals for international control of atomic energy, this condition never was fulfilled and the restriction ended the wartime nuclear collaboration of the United States, the United Kingdom, Canada and Belgium. The only cooperation permissible after 1946 was in exploration for and procurement of uranium ores. Five years later Congress slightly relaxed the restrictions by authorizing the Atomic Energy Commission to exchange certain information with other countries about the "refining, purification and subsequent treatment of source materials, reactor development, production of fissionable material, and research and development.* In this amendment Congress laid down

* Public Law 82-235, 65 Stat. 692.

four limitations for U.S. technical assistance in nuclear energy limitations that were retained in the subsequent overhaul of the atomic energy legislation of 1954.

These limitations were:

(1) a prohibition against communication of weapons design and fabrication data;

(2) a requirement for adequate security standards in countries receiving classified information;

(3) a determination by the President that the arrangements would promote and would not endanger the common defense and security; and

(4) a requirement that the Joint Committee on Atomic Energy be informed of the arrangement 30 days prior to its consumation.

Statutory limitations.--When Congress rewrote the Atomic Energy Act in 1954, it greatly expanded the scope for international cooperation in civil nuclear energy, but within specific statutory restrictions. The Atomic Energy Act of 1954 provides the authority for the Energy Research and Development Administration to cooperate with any nation by distributing nuclear fuel and source materials and certain radioisotopes. This international cooperation is effected through bilateral agreements for cooperation with individual nations or groups of nations. As for limitations upon these agreements, in Section 123 of the Act, Congress required that each such agreement must include:

(1) the terms, conditions, duration, nature, and scope of the cooperation;

(2) a guaranty by the cooperating party that security safeguards and standards agreed upon will be maintained;

(3) a guaranty by the cooperating party that any material and any restricted data to be transferred will not be transferred to unauthorized persons or beyond the jurisdiction of the cooperating party except as specified in the agreement.*

Section 123 further requires the President to approve each agreement for cooperation and to make a written determination that the proposed agreement will promote rather than constitute an unreasonable risk of the common defense and security. Finally, Congress preserved for itself the option to intervene by requiring that a proposed agreement for cooperation, together with the President's approval and determination must lie before the Joint Committee for 30 days while Congress is in session. Last year Congress expanded this opportunity for congressional review in Public Law 93-485. It requires all agreements for cooperation, and amendments to them, involving reactors producing more than five megawatts of thermal energy be submitted to the Congress and referred to the Joint Committee on Atomic Energy, and a period of 60 days elapse while Congress is in session. But any such proposed agreement can not become effective if during this time Congress passes a concurrent resolution that it does not favor the proposed agreement. Before the end of the first 30 days, the Joint Committee on Atomic Energy also is required to report its views and recommendations respecting the proposed agreement and to provide a proposed concurrent

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* Restricted data is a term with special meaning under the Atomic Energy Act of 1954. It is defined as "all data concerning (1) design, manufacture, or utilization of atomic weapons; (2) the production of special nuclear material; or (3) the use of special nuclear material in the production of energy, but shall not include data declassified or removed from the Restricted Data category..."

resolution stating in substance that the Congress favors, or does not favor, the proposed agreement.

Negotiation of the agreements.--The agreements for cooperation are initially drafted by ERDA and submitted to the Department of State for review and comment. At this point the intent of the executive branch to enter into negotiation of an agreement is brought to the attention of the Joint Committee on Atomic Energy. After an agreed text has been developed, ERDA presents it to the foreign party for consideration. Once agreement is reached, the revised text must be approved by the ERDA Administrator and the Department of State. After the approved text has been initialed by ERDA, the State Department and the other party, ERDA submits the agreement to the President for approval. At this point there is staff review in the Executive Office to provide the basis for the President's written determination and approval. Following this determination and approval, the agreement is formally signed by ERDA and the State Department, on behalf of the United States, and the other party and the agreement is submitted to Congress for the statutory period.

Contents of agreements.--An agreement for cooperation provides the framework for subsequent individual transactions covering the supplying or exchange of information, materials, equipment, or facilities. The agreements typically contain limitations on the total amount of enriched uranium which may be transferred. Requests for significant quantities of uranium enriched to more than 20 percent, that is, over 5 kilograms of contained U-235, are considered case by case and, at a minimum, must satisfy the

executive branch as to economic or technical merit and acceptability of applicable physical security measures to protect the materials. Also, transfers can take place only within the period of the agreements.

Concerning safeguards, these are defined in agreements to mean "a system of controls designed to assure that any materials, equipment and devices committed to the peaceful uses of atomic energy are not used to further any military purpose." This definition is out of date in that it does not recognize the problem of theft for criminal or terrorist purposes, nor does it apply to information and technology. In the first agreements for cooperation, the United States obtained for itself the right to send U.S. inspectors into the other country to verify quantities and use of materials and equipment supplied. The early agreements also included a provision for consultation on transferring U.S. safeguards to an international agency when it was formed. The initial U.S. policy for control over U.S. supplied items was established in the late 1950s by the AEC in consultation with the Department of State. The policy provided that:*

> (1) the United States would give assistance and advice to the recipient country in establishing a national system of control over materials and equipment, including adequate materials accountability and physical control measures;
>
> (2) the system would be subject to audit, appraisal and verification by United States personnel;
>
> (3) the specific measures applied in auditing and verifying the system would depend upon the type and complexity of the facility involved and the type and quality of the material involved; and

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* U.S. Atomic Energy Commission. Major Activities in the Atomic Energy Programs. January-December 1959. Washington, D.C.: U.S Government Printing Office, 1960, p. 110.

(4) the AEC staff would provide assistance and guidance to cooperating countries.

The United States has used this safeguards authority. For example, in 1969 AEC inspectors made 52 inspections of facilities in five countries. The era of AEC inspections lasted until 1963 when the AEC, Japan and the International Atomic Energy Agency signed the first tri-lateral agreement which provided for the Agency to safeguard any nuclear material, equipment and facilities supplied to Japan by the United States. This trilateral agreement also specified that Agency safeguards would apply to any nuclear material produced in the Japanese facilities upon its return to the United States for reprocessing unless the U.S. substituted an equivalent amount of material in Japan. This last provision was to prevent IAEA safeguards from following the returned materials into the United States. The trilateral agreements suspend the U.S. safeguards rights while IAEA safeguards are in effect.

Status of agreements.--In 1975 the United States had thirty agreements for cooperation in civil uses of atomic energy. Of these, 20 were for cooperation in nuclear research and power, two were for power only, and eight for research only. The United States also had bilateral agreements with Euratom and the International Atomic Energy Agency. Table V lists the agreements showing scope and term.

The Non-Proliferation Treaty

While diversion of nuclear materials from the civilian nuclear power fuel cycle is often pointed out as a plausible route to proliferation, the route used to date to acquire materials for weapons has been to build much simpler

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Table V

I. BILATERAL AGREEMENTS FOR COOPERATION IN THE CIVIL USES OF ATOMIC ENERGY

A. Bilaterals with individual countries:

Country	Scope	Effective date	Termination date
Argentina	Research and power	July 25, 1969	July 24, 1999
Australia	do	May 28, 1957	May 27, 1997
Austria	do	Jan. 24, 1970	Jan. 23, 2000
Brazil	do	Sept. 20, 1972	Sept. 19, 2002
Canada	do	July 21, 1955	July 13, 1980
China, Republic of	do	June 22, 1972	June 21, 2014
Colombia	Research	Mar. 29, 1963	Mar. 28, 1977
Finland	Research and power	July 7, 1970	July 6, 2000
Greece	Research	Aug. 4, 1955	Aug. 3, 1974
India	Power (Tarapur)	Oct. 25, 1963	Oct. 24, 1993
Indonesia	Research	Sept. 21, 1960	Sept. 20, 1980
Iran	do	Apr. 27, 1959	Apr. 26, 1979
Ireland	do	July 9, 1958	July 8, 1978
Israel	do	July 12, 1955	Apr. 11, 1975
Italy	Research and power	Apr. 15, 1958	Apr. 14, 1978
Japan	do	July 10, 1968	July 9, 2003
Korea	do	Mar. 19, 1973	Mar. 18, 2014
Norway	do	June 8, 1967	June 7, 1997
Philippines	do	July 19, 1968	July 18, 1998
Portugal	do	June 26, 1974	June 25, 2014
South Africa	do	Aug. 22, 1957	Aug. 21, 2007
Spain	do	June 28, 1974	June 27, 2014
Sweden	do	Sept. 15, 1966	Sept. 14, 1996
Switzerland	do	Aug. 8, 1966	Aug. 7, 1996
Thailand	do	June 27, 1974	June 26, 2014
Turkey	Research	June 10, 1955	June 9, 1981
United Kingdom	do	July 21, 1955	July 20, 1975
Do	Power	July 15, 1966	July 14, 1976
Venezuela	Research and power	Feb. 9, 1960	Feb. 8, 1980
Vietnam	Research	July 1, 1959	June 30, 1979

B. Bilaterals with International organizations:

Organization	Scope	Effective date	Termination date
European atomic energy community (Euratom).	Joint nuclear power program	Feb. 18, 1959	Dec. 31, 1985
Euratom	Additional agreement to joint nuclear power program.	July 25, 1960	Dec. 31, 1995
International Atomic Energy Agency (IAEA)	Supply of materials, etc.	Aug. 7, 1959	Aug. 6, 2014

Source: U.S. Congress. Senate. Committee on Banking, Housing and Urban Affairs. Subcommittee on International Finance. Exports of Nuclear Materials and Technology. Hearings, 93d Congress, 2d session. July 12 and 15, 1974. Washington, U.S. Govt. Print. Off., 1974. p. 14.

facilities designed for production of fissionable materials only. Of the five nations possessing nuclear weapons or explosives, not one obtained the materials from the fuel cycle of civilian nuclear power. The Indian "peaceful" device that was tested in 1974 likewise did not obtain its plutonium from civilian nuclear powerplants. It was largely in recognition of the fact that many nations could make nuclear weapons materials directly rather than divert them from nuclear powerplants that the U.S. formulated, proposed and promoted the adoption of the Non-Proliferation Treaty, which finally entered into force on March 5, 1970.

The non-weapons states represent a substantial nuclear undertaking. In 1970, 11 states other than the weapons states were operating nuclear powerplants. The capacity of these plants was about 5,000 megawatts, of which nearly half was under safeguards of the International Atomic Energy Agency. By mid-1975, the total nuclear power capacity outside the weapon states had grown to 24,000 MW in 15 countries.

As seen by the State Department, the NPT goes far beyond U.S. bilateral agreements by requiring a nonnuclear weapons state to commit itself not to acquire nuclear weapons from any source, and to subject all of its independent and indigenous nuclear activities to a peaceful use undertaking, verified by inspections by the IAEA. In this way the NPT closes the gap that fissionable materials for nuclear explosives could be acquired through essentially unassisted efforts of a particular nation. The NPT is thus a key element in achieving non-proliferation and the U.S. position is to strongly support the broadest possible adherence to the treaty.*

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* July hearings, p. 6

Professor Willrich emphasized that the concept of the NPT as a legal barrier against nuclear proliferation rests on the premise that fewer is better with respect to the number of weapons nations. This initial premise rests on the further premises that: (1) the security in non-weapons nations will be diminished if one or more of them acquires nuclear weapons; and (2) even the security of a nation acquiring such weapons will not necessarily be increased thereby.*

The NPT requires a non-weapons party to renounce its right to make or acquire nuclear weapons or explosive devices. It also requires such a party to accept the application of IAEA safeguards on all their civilian nuclear activities. Any party to the treaty, both those that have nuclear weapons and those who do not, may export nuclear materials and equipment for peaceful purposes to any non-weapons countries if the importing country accepts IAEA safeguards for the supplied materials. There is no ban on exports to non-NPT nations.

The NPT recognizes the inalienable right of all parties to "develop, research, production and use of nuclear energy for peaceful purposes except for the manufacture of nuclear explosive devices." In addition, and by way of partial mitigation for the discrimination between the weapons and non-weapons states, all parties to the NPT agree to facilitate to the fullest extent exchange of equipment, materials and information for civilian nuclear applications. Moreover, those parties in a position to do so are required to cooperate in contributing to civilian nuclear applications,

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* April-May hearings, p. 752.

especially in the non-weapons parties, with due regard to the needs of developing countries.

Parties to the NPT.--As noted, the NPT identifies two classes of nations: those which have the bomb and those which do not. Among the weapons nations, the United States, the United Kingdom and the Soviet Union are parties to the NPT; France, India and the People's Republic of China are not. Of 93 non-weapons states which had signed the NPT through June 30, 1975, 15 had not ratified it, including the industrial nations Italy and Japan. Israel has not signed the NPT, nor has Argentina, Brazil, Chile, Pakistan, Portugal or Spain. Among the Organization of Petroleum Exporting Countries, Iran and Iraq have signed and ratified the NPT, Libya and Egypt have signed but not ratified; Saudi Arabia and Algeria have not signed.

The offer to place U.S. facilities under IAEA safeguards.--One impediment to commitment to the NPT among non-weapons nations has been concern that their nuclear industries might be put at a disadvantage in comparison with those of the weapons states by IAEA inspections. This concern was expressed particularly by Italy, West Germany and Japan. To offset this argument, President Johnson, when he signed the NPT on July 1. 1968, offered to voluntarily place U.S. commercial nuclear power under IAEA safeguards.* A similar offer was made by the United Kingdom. The

* When signing the treaty, President Johnson said: "We will cooperate fully to bring the Treaty safeguards into being. We shall thus help provide the basis of confidence that is necessary for increased cooperation in the peaceful nuclear field. After the Treaty has come into force, we will permit the International Atomic Energy Agency to apply its safeguards to all nuclear activities in the United States--excluding only those with direct national security significance. Thus the United States is not asking any country to accept any safeguards that we are not willing to accept ourselves."

Soviet Union did not join in these offers. Its position was that inspection of any atomic activities within a weapons country was unnecessary and irrevelant, for the Treaty did not prohibit them from possession of weapons. President Johnson's offer was subsequently reaffirmed by Presidents Nixon and Ford.

According to the State Department, in addition to its "crucial importance" in ensuring the adherence to the treaty of other industrialized nations, implementation of the U.S. voluntary offer will provide the IAEA with an important means for improving its safeguards techniques and experience. It will also allow the U.S. to assert much more effectively its leadership role in international safeguards.* If the U.S. offer is indeed as important as the State Department indicated, it is difficult to understand why six years after the entry into force of the NPT the U.S. has still to conclude its negotiations within the IAEA to fulfill this offer.

Major loopholes.--The NPT relies upon the IAEA to verify through inspections that nuclear materials are not diverted from peaceful uses into weapons or other nuclear explosives. While non-weapons parties have committed themselves to place all their nuclear programs under IAEA safeguards, the NPT does not prohibit the transfer of nuclear materials to countries which have not signed the NPT. The only limitation is that these countries must agree to IAEA safeguards for the items covered by the transaction. Thus a non-NPT country could develop its own unsafeguarded nuclear capabilities, drawing upon the experience and trained manpower

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* July hearings, p. 7.

of the safeguarded activities without diverting the safeguarded materials and facilities. Dr. Herbert Scoville sees this as creating a major loophole for the eventual acquisition of nuclear weapons by non-NPT nations.* Indeed, India made use of this loophole to produce its first nuclear explosive.

Another potential danger is the possible abrogation of the treaty by a non-weapons nation after it has acquired fissionable material as part of a legitimate peaceful program. Under the NPT, a nation can withdraw after three months notice with no penalties.

The NPT review conference.--In May 1975 a review conference of NPT members was held as required by Article VIII of the treaty.** The participants included 58 states party to the NPT and seven states that had signed but not ratified the NPT. Seven more states were represented by observers. The Conference supported the Agency's safeguards programs, its advisory work on physical protection of nuclear materials, its study of the concept of nuclear fuel cycle centers and its work in relation to peaceful nuclear explosives. The Conference recommended that the Agency should increase its technical assistance and related activities for the benefit of developing states party to the NPT. Concerning policies for exports of nuclear materials and products, the Conference urged that "...in all achievable ways,

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* Cf., Herbert Scoville, Jr., U.S. Nuclear Export Policies. Reprinted in the July hearings, p. 100.

** Article VIII provides that: "Five years after the entry into force of this Treaty, a conference of Parties to the Treaty shall be held in Geneva, Switzerland, in order to review the operation of this Treaty with a view to assuring that the purposes of the Preamble and the provisions of the Treaty are being realized.

common export requirements relating to safeguards be strengthened, in particular by extending the application of safeguards to all peaceful nuclear activities in importing states not party to the Treaty."

The Conference also stated that it considered the IAEA to be the appropriate international body through which potential benefits from peaceful applications of nuclear explosions could be made available to any non-nuclear weapons-state.

Considering the potential importance of this conference, it seems somewhat surprising that it has had little visible effect to date, particularly on the troublesome issue of getting developing nations such as Brazil and Argentina to become parties. As part of its continuing oversight, the Subcommittee may wish to inquire into the goals of the U.S. participants in the conference, the influence of U.S. participation, and the significance of its outcome for U.S. nuclear policy.

International Atomic Energy Agency Safeguards

Any significant nuclear export from the United States to a non-weapons country is subject to IAEA safeguards either because the importing nation is a party to the NPT or because its agreement with the United States requires the export to be placed under IAEA safeguards. So the IAEA and its safeguards form an important part of the international framework to limit proliferation in an era of growing nuclear exports. The adequacy of these safeguards has become of concern to some Members of Congress and, as will be seen later, there are proposals that the Nuclear Regulatory Commission in licensing exports should assure itself that safeguards of the

receiving country are adequate. There follows some background information on the IAEA, and a discussion of its safeguards functions, their adequacy, and what happens if a diversion is detected.

The International Atomic Energy Agency. --The IAEA is an international organization that came into being on July 29, 1957, to promote the peaceful uses of atomic energy. While independent from the United Nations, it is a member of the family of international organizations that report annually to the United Nations General Assembly. In some instances, the IAEA may report to the Security Council or to the Economic and Social Council. The IAEA has established relationship agreements with five other specialized agencies of the United Nations. By October 1975 the number of IAEA member states totalled 109. Members included all of the Common Market countries and all nations of industrial consequence, as well as developing nations. The Agency is located in Vienna, Austria.

The objectives of the Agency stated in the international statute that created it are to seek to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world. The Agency is to ensure, so far as it is able, that assistance provided by it or at its request or under its supervision or control is not used in such a way as to further any military purpose.

The international statute provides for three principal parts of the organization: a General Conference, a Board of Governors and a Secretariat headed by a Director General. The General Conference meets annually to discuss and make recommendations on any issue within the scope of the

Statute. The Board of Governors has a uniquely sweeping authority in the international family. The Statute gives the Board broad authority to "carry out the functions of the Agency." The Board appoints the Director General with the approval of the General Conference and submits an annual budget to the General Conference, which can accept or reject it, but not change it. The Secretariat is headed by the Director General who is appointed for a term of four years. Dr. Sigvard Eklund of Sweden is the current Director General. He was reappointed for his fourth four-year term in the fall of 1973. As a point of interest, the first Director General was Sterling Cole, a Member of Congress who served as first chairman of the Joint Committee on Atomic Energy and left that post to become Director General.

Origins of the IAEA.--The origins of the IAEA are traced to President Eisenhower's Atoms for Peace address to the General Assembly of the United Nations in December 1953. In that address the President forecast that the knowledge of nuclear power which some nations then possessed would eventually be shared by others, a forecast which has come to pass. To reverse the trend of atomic military buildup, he proposed peaceful uses of nuclear power because nuclear materials committed to peaceful purposes presumably would not be available for weapons. To this end he proposed that the nuclear nations, then primarily the Soviet Union and the United States, contribute fissionable materials to an international pool to be administered by an international agency. The pool would supply nuclear fuel for electricity to power-starved areas of the world. Safeguards were also a contemplated function. The agency would be responsible for the

impounding, storage and protection of the pool of materials. President Eisenhower stated: "The ingenuity of our scientists will provide special safe conditions under which such a bank of fissionable material can be made essentially immune to surprise seizure."

The initial burst of enthusiasm for the President's proposal did not galvanize quick international action and it took almost four years to create an International Atomic Energy Agency with a less grandiose charge.

IAEA safeguards.--The Agency's function which is probably of greatest importance for limiting proliferation of nuclear weapons is its safeguards function. The IAEA statute authorizes the Agency to establish and administer safeguards designed to ensure that special fissionable and other materials, services, equipment, facilities, and information made available by the Agency or at its request or under its supervision or control are not used in such a way as to further any military purpose; and to apply safeguards, at the request of the parties, to any bilateral or multilateral arrangement, or at the request of a state to any of that state's activities in the field of atomic energy. With respect to any Agency project, or other arrangement where the Agency is requested to apply safeguards, the Agency has specific rights and responsibilities, to the extent relevant to the project or arrangement to:

(1) examine the design of specialized equipment and facilities, including nuclear reactors, and to approve it only from the viewpoint of assuring that it will not futher any military purpose, that it complies with applicable health and safety standards, and that it will permit effective application of IAEA safeguards;

(2) require the observance of any health and safety measures prescribed by the Agency:

(3) require the maintenance and production of operating records to assist in ensuring accountability for source and special fissionable materials used or produced in the project or arrangement;

(4) call for and receive progress reports;

(5) approve the means to be used for the chemical processing of irradiated materials solely to ensure that this processing will not lend itself to diversion of materials for military purposes and will comply with applicable health and safety standards;

(6) require that special fissionable materials recovered or produced as byproducts be used for peaceful purposes under continuing Agency safeguards

(7) require deposit with the Agency of any excess of any special fissionable materials recovered or produced as byproducts over what is needed for use in order to prevent stockpiling of these materials;

(8) send inspectors into the territory of the recipient state or states, who shall have access at all times to all places and data and to any person who deals with materials, equipment, or facilities which are safeguarded, as necessary to account for source and special fissionable materials supplied and to determine whether there is compliance with the undertaking against use for military purposes, with health and safety measures, and with any other conditions prescribed in the agreement between the Agency and the state or states concerned;

(9) in the event of non-compliance and failure by the recipient state or states to take requested corrective steps within a reasonable time, to suspend or terminate assistance and withdraw any materials and equipment made available by the Agency or a member for the project.

To date the IAEA has exercised its inspection functions to verify the records, amounts and uses of nuclear materials, but has not exercised the latent health and safety function specified in the Statute.

IAEA safeguards apply within a state either because it is a party to the NPT or because it has signed an agreement with a supplier state that requires the materials and equipment supplied to be under IAEA safeguards. The principal difference, as noted earlier, is that in an NPT non-weapons state the IAEA can inspect all nuclear materials and facilities, whereas for a non-NPT state, the IAEA safeguards and inspectors are limited to the materials and facilities specified in an agreement for cooperation. This difference was important to the Indian Government in its rationalizing of its development and test of a nuclear explosive using its own uranium which was not under IAEA safeguards in a Canadian-supplied reactor which was under safeguards.

IAEA safeguards and national safeguards ideally form a coherent whole with each performing its own function. IAEA safeguards are not a substitute for effective national safeguards. Conversely, without effective national safeguards, IAEA safeguards will be ineffective. The principal objective of IAEA safeguards is to assure prompt detection of diversion. The objective of national safeguards systems is to detect diversion or theft by

an internal group. In the United States, safeguards also have the second objective of assuring protection against robbery or sabotage.

According to ERDA, there are three principal components of safeguards systems in general: accountability, physical inspection and instrumentation. The IAEA safeguards system keeps records of all material under safeguards which is made available to a country, transferred out of a country, or in the reactors and in storage. As for physical inspection, IAEA inspectors may make a few visits, and they may be unannounced, to a facility to insure it is being operated as prescribed and the material is stored or used where it is supposed to be; or IAEA inspection can call for the almost constant presence of an inspector, depending upon the nature and quantity of the materials. As for technology, the use of tamperproof monitors, seals and cameras in sensitive areas can detect and record any unauthorized access.*

Before the IAEA can apply its safeguards, the country involved must conclude a safeguards agreement with the Agency. As of June 30, 1975, the Agency had concluded safeguards agreements with 53 non-weapons States and had 43 safeguards agreements in force. These agreements covered 47 nuclear power stations, 115 other reactors, 29 fuel cycle facilities and 195 other nuclear materials accountability areas. Table VI gives details. The Agency reports that nuclear materials under its safeguards increased from 824 kilograms of plutonium and 4.6 tons of contained U-235 in 1969, to 6,300 kilograms of plutonium and 43 tons of contained U-235 in 1974.**

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*Cf., statement of A. Friedman, ERDA, July hearings, p. 41.

** International Atomic Energy Agency. Annual Report: 1 July 1974--30 June 1975. Report GC (XIX) 544, p. 40.

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Table VI

FACILITIES UNDER IAEA SAFEGUARDS

Facilities	NPT		Non-NPT	
	30 June 1974	30 June 1975	30 June 1974	30 June 1975
Nuclear power stations	12	17	24	30
Other reactors	45	55	65	60
Conversion plants, fabrication plants and fuel reprocessing plants	7	9	19	20
Other separate accountability areas	28	86	88	109

Source: International Atomic Energy Agency. Annual report: 1 July 1974-30 June 1975. Report GC(XIX)/544, p. 40.

During the year ending June 30, 1975, the Agency carried out 502 inspections in 37 states. Of these, 178 were for powerplants, 97 for bulk fuel fabrication plants and 227 for other facilities including research reactors.*

The physical protection issue.--IAEA safeguards form a system for verifying accounts for nuclear materials by audit and inspection. They are intended to detect theft or diversion. The international statute does not authorize the Agency to prescribe requirements for physical security of nuclear materials and facilities or to inspect for compliance. Lacking such authority, the IAEA is limited to providing guidance and recommendations for the physical protection. The latest version of this IAEA guidance was issued in September 1975.** After noting that it has no responsibility either for the provision of a state's physical protection system or for the supervision, control or implementation of such a system, the IAEA set down two objectives for state systems and two objectives for the Agency. These follow:

> The objectives of the state's physical security protection system should be:
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> (a) to establish conditions which will minimize the possibilities for unauthorized removal of nuclear material or for sabotage, and
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> (b) to provide information and technical assistance in support of rapid and comprehensive measures by the state to locate and recover missing nuclear material.

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* Ibid.

** International Atomic Energy Agency. The physical protection of nuclear material. INFCIRC/225, September 1975, 19 p.

The objectives of the Agency are:

(a) to provide a set of recommendations on requirements for the physical protection of nuclear material in use, transit and storage,* and

(b) to be in a position to give advice to a state's authorities in respect of their physical protection system at the request of the state.

The IAEA efforts have been welcomed. However, and as NRC Commissioner Gilinsky cautioned, it is important to understand that IAEA's role in physical protection is purely advisory. The IAEA can recommend standards for physical protection of nuclear materials in use, storage and transit, but acceptance of these recommendations is up to each state and is not mandatory. Commissioner Gilinsky sees good reason for confidence that governments will indeed cooperate for physical security. "It is, after all, a clear matter of mutual security to protect against the theft of nuclear materials or the sabotage of nuclear facilities."**

Since IAEA safeguards do not extend to physical security, the United States in its nuclear export policy has become concerned that physical security measures in the recipient nation are adequate. It is NRC policy for "significant" exports of plutonium and highly enriched uranium (that is more than five kilograms of enriched uranium or two kilograms of plutonium) to require the physical security systems in the recipient country to

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* The recommendations are provided for consideration by the competent authorities in the states. Such recommendations could provide guidance but could not be mandatory upon a state and would not infringe on the sovereign rights of states.

** July hearings, p. 51.

be acceptable to the United States as a condition for an export license.* On the other hand, it was not evident from the Subcommittee's hearings what criteria would be applied by the NRC in judging the acceptability of foreign physical security. In replying to a question about variations in physical security measures, NRC Commissioner Gillinsky said:**

> I think you have to consider the individual circumstances in that country. We have not come up with a hard and fast rule on this matter. For example, there are some countries where crime is a good deal less common than it is in others. There are some countries which are more stable than others. I would imagine we would require somewhat different degrees of control.

When further asked whether the United States should require foreign physical security to at least equal what is required of domestic licensees, Mr. Gilinsky said.***

> Let me say those standards apply to the specific situations in the United States--where we have private utilities, where nuclear industry is in private hands and so on--there are other countries where these activities are all under governmental control. So the degree of additional control required may well differ from country to country. I don't think that should be a surprising fact or conclusion.

Enforcement and sanctions.--One recurring issue was the use of sanctions to discourage or rectify violation of safeguards. The IAEA statute provides for its inspectors to report any non-compliance to the Director General who is to report to the Board of Governors. The Board is to call upon the state involved to remedy its non-compliance. If that fails, the IAEA is to report the non-compliance to all members of the Security

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* Ibid., p. 56.

** Ibid., p. 57.

*** Ibid., p. 49.

Council and to the General Assembly of the United Nations. In the history of the Agency, this has never been done. Should a nation fail to take fully corrective action within a reasonable time, the Board may take one or both of the following measures:

(1) direct curtailment or suspension of assistance being provided by the Agency or by a member,

(2) call for return of materials and equipment made available to the state.

The Agency may also suspend any non-complying member from the exercise of the privileges and rights of membership.

For violation of safeguards agreements with the IAEA under a trilateral agreement, the agreement between the supplier and importing countries could have additional provisions. In the case of U.S. agreements, various sanctions are provided. According to the State Department, if violations were to occur, a full investigation would be made followed by every effort to reach an amicable correction. If this failed, the agreements would give the United States the right to do two things: first, discontinue any further shipments, any further supply arrangements; and, second, require the return of all materials and equipment which were provided.*

These sanctions are not impressive, although they are probably the best that can be negotiated. This pessimistic view is shared by NRS Commissioner Gilinsky who sees no substantial IAEA sanctions attached to its safeguards.**

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* Ibid., statement of Myron Kratzer, Department of State, p. 18.

** Ibid., p. 61.

While no violations of IAEA safeguards have been reported, according to witnesses, it would seem unrealistic to expect that as world nuclear power grows and international tensions fluctuate, there will be none in the future. Yet there appears to be little advance or contingency planning to deal with a reported violation. One major consideration in such planning would be the extent of possible unilateral U.S. sanctions. For example, would the United States unilaterally cut off some or all U.S. foreign and military aid to a violator? Would it go so far as to cut off U.S. food supplies?* There are no simple answers to these questions, for part of the answer must be a balancing of the seriousness of the violation against the potency of the sanctions and the impacts of their use. One does not use an elephant gun to shoot a fly, or a fly swatter to stop an elephant. Nonetheless, in the light of the importance of an effective international safeguards system

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* The idea of using the threat of cutoff of U.S. food exports to dissuade nations from testing nuclear explosives was proposed by a floor amendment to the International Development and Food Assistance Act during Senate consideration of this legislation (H.R. 9005). An amendment was proposed to prohibit assistance under the Foreign Assistance Act of 1961 or the Agricultural Trade Development and Assistance Act of 1954 to any country which has detonated a nuclear explosive device within five years of the time such assistance is proposed to be provided. The amendment was tabled after considerable debate. The essence of the opposition is evident in the following remarks by a Senator speaking against the amendment:

> The Government is engaged in a foreign assistance program not because we love everybody else in the world but because we think it is good national policy and because the American people overwhelmingly, in every survey of public opinion, have stated that they are prepared to share and share and share our food. For Congress to place a roadblock to assistance to a country like India merely because she has detonated a nuclear explosive within the late five years is to cut off our nose to spite our face.

Cf., Congressional Record, November 4, 1975, p. S19209 (daily edition).

witnesses saw an urgent need for tested contingency planning mechanisms and, ideally, for some preliminary plans.

IAEA safeguards assessed.--As more nations reach the threshold of greatly increased use of nuclear energy--and assuming that certain perplexing safety, economic and technological problems are favorably resolved-witnesses felt that it is time to think about the accomplishments of IAEA safeguards to date and their prospects for the future.

First of all, the Agency has pioneered the practice of inspection of national activities by international inspectors. The very fact that IAEA inspectors can get access to nuclear materials and facilities in states with which they have signed safeguards agreements is a striking accomplishment that should not now be overlooked because it has become commonplace.

Having said this, one must also note that the work of IAEA's inspectors is essentially at the forebearance of the inspected state. Any nation may, withdraw from the NPT or from the IAEA with no penalty and close its borders to inspection.

Again on the positive side, the IAEA safeguards inspections and other activities provide a useful cross-check upon the workings of domestic nuclear materials accountability systems.

In terms of the ability of IAEA safeguards to slow or impede proliferation, the views of Commissioner Gilinsky are important. He sees much that is valuable in IAEA safeguards but would not mistake them to be an infallible, magic answer. His advice was:*

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* July hearings, p. 51.

> U.S. policy on preventing the spread of nuclear weapons relies heavily on the Nonproliferation Treaty and international inspections administered under that treaty. The treaty is not universal; a number of countries important in this context are not parties to it. The IAEA inspection system, which has begun to take on some fiber as a consequence of the IAEA's responsibilities under the treaty, is still a slender reed. The chief value of IAEA safeguards under the NPT is that their acceptance is a demonstration of an intention, at least for the present, to resist the temptation to build nuclear weapons.
>
> These inspections cannot, of course, cope with an abrogation of the NPT after acquisition of civilian facilities and materials transferable to military purposes. Moreover, as a broad array of nuclear technology is deployed the leadtime to turn this technology to military uses will be reduced and the value of the inspections will be lessened accordingly. Nevertheless, we have been working hard at strengthening this system. And if it is not overstrained, the inspection system could provide a vital alarm which, if it came early enough, could allow time for preventive action.

In looking at the safeguards situation, Dr. Taylor spoke of new opportunities for improving national safeguards that are likely to substantially increase confidence in the United States safeguards system. At the same time, he saw strong indications that other countries are becoming concerned about possible theft of nuclear materials within their borders by terrorists or other criminals. It is in their national interests to take steps to assure the physical security of these materials. As for IAEA safe- against further national proliferation, he was much less optimistic, saying:*

> ...As far as technology and economics are concerned, I can visualize a system of IAEA safeguards that would make it very difficult for a country to divert nuclear materials from peaceful to military applications without detection. But an IAEA safeguards system that is highly effective in detecting diversion where it is applied will not directly inhibit proliferation in countries that refuse to accept IAEA safeguards, or in countries that decide to abrogate agreements for one reason or another.

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* July hearings, p. 75.

> To put it bluntly, I must say that any country in the world that really wants nuclear weapons during the next several decades will be able to acquire them, one way or another.

The demand upon IAEA safeguards will soon increase. One increase will come when Euratom gives final notice to the Agency of its acceptance of a safeguards agreement under which the IAEA will apply its safeguards to the nuclear activities of much of the European nuclear industry. The other increase will come when negotiations are finally completed between the IAEA and the United Kingdom and the United States to voluntarily place some nuclear installations of these two nuclear weapons states under IAEA safeguards. Even to place a few selected installations of the U.S. and U.K. nuclear industries under IAEA safeguards will increase the requirements for inspectors and funding for their salaries and travel expenses. Complicating the situation are the prospects for safeguarding fuel reprocessing plants which, in many ways, will be the most troublesome part of the whole nuclear fuel cycle. The IAEA has had some experience with small fuel reprocessing plants of the Nuclear Energy Agency of the Organization for Economic Cooperation and Development (OECD), but it is not clear how well prepared IAEA safeguards systems, personnel and technical capabilities will be to deal with large scale, commercial reprocessing. There will still be some time to prepare, for the NRC on November 12, 1975, announced that it would not decide upon the future licensing of plutonium recycle for another 18 months. There is little point in reprocessing spent nuclear fuel if the recovered plutonium cannot be reused as fuel. During these coming months NRC intends to inquire in depth into the safeguards

aspects of plutonium recycle. Similarly, successful demonstration of the commercial utility of the centrifuge method of enrichment now being developed in Europe could increase demands upon IAEA safeguards if various nations apply this technology to attain their own independence for enriched fuels.

On the whole, the next few years appear as a critical time both for development and carrying out of a strong U.S. policy to strengthen IAEA safeguards, and the corresponding increase in this IAEA capability. These seemingly straightforward purposes may, however, feel the backlash of the ultimate United States reaction to the United Nations resolution in 1975 that equated Zionism with racism. If U.S. participation in international organizations is lessened, then it is none too early to consider the implication of such policy for the IAEA and its future effectiveness as a limited deterrent to further proliferation.

International or Regional Nuclear Fuel Cycle Facilities

The fewer installations that are involved in making or processing nuclear materials, the fewer are the points of exposure to theft or diversion. Likewise, large regional plants operated in the glare of full publicity as multinational ventures are expected to be less susceptible to theft or diversions of nuclear materials than would be many small, scattered plants operating in near secrecy. Safeguarding a few large plants appears more likely to be effective than trying to safeguard a comparable output from many, scattered plants. So it was not surprising that many witnesses before the Subcommittee favored the concept of regional, multinational plants for enrichment and fuel processing, and perhaps for fuel fabrication.

The State Department cautioned that reprocessing and enrichment facilities present difficult safeguards problems. Effective safeguards for facilities of this type will require continuous attention and probably resident IAEA inspectors. Even were regional facilities to be effectively safeguarded, there is the possibility that their technology might be acquired and used in unsafeguarded activities of member countries. Because of the proliferation potential of reprocessing and enriching facilities, the United States does not favor the widespread introduction of these facilities among many nations.* So the State Department also favors regional centers to minimize the number of such plants and at the same time to reduce their proliferation risk. The State Department reported to the Subcommittee that the IAEA is currently undertaking a feasibility study of such centers. The U.S. strongly favors this study and has urged other IAEA member states to give it their full support.*

Reprocessing and enrichment of nuclear fuel outside the United States under multinational management, preferably under the IAEA, was also favored by industry witnesses** and also by Ms. Cahn of Harvard University.*** She further recommended that Congress veto any agreement for cooperation with Iran which does not provide for reprocessing on a regional or international framework.

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* Cf., statement of M. Kratzer, State Department, July hearings, p. 8.

** Cf., statement of A.L. Bethel, Westinghouse Electric Corp., Ibid., p. 63.

*** April-May hearings, p. 742.

Dr. Scoville proposed that the best form of control for proliferation risks from nuclear fuel reprocessing is not through bans on technology exchange, which might be impossible to enforce, but through a positive program of internationally managed centers to satisfy the reprocessing requirements of many different countries. These centers could also have fuel fabrication and storage facilities colocated in them. This would provide a sound economic approach, reduce the safety problems, and most importantly, decrease the risks that the processed plutonium could be diverted or turned into weapons. The availability of such centers would reduce the pressure on supplier nations to help other nations build national facilities. This approach should be pursued with urgency as part of a broader effort to encourage the multinational ownership and operation of chemical reprocessing, fuel fabrication and associated material storage facilities.*

Informal Agreement Among Nuclear Supplier Nations

The international framework for measures to limit proliferation includes also an informal element which may in time have to become more formal. This refers to the informal agreement among the governments of the nuclear supplier nations upon common policies for nuclear exports. During the last year there have been informal and confidential negotiations between the United States, France, the Soviet Union, the United Kingdom, West Germany and perhaps other governments. Congressional attempts to find out more about U.S. participation in these negotiations have not been particularly successful. The importance of obtaining a better understanding

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* Ibid., p. 754.

is underscored by advice at the hearings that the success of non-proliferation efforts is critically dependent on the policies not simply of the United States but of all major suppliers, and that the goal of non-proliferation can be more effectively realized if suppliers "...adopt certain restraints which go beyond the NPT undertaking, to supply nuclear materials and equipmennt only under safeguards."*

A decade ago the United States probably could have dominated such negotiations. Now, as Commissioner Gilinsky observed, the United States no longer controls the spread of nuclear technology thoughout the world. The ability of the United States to prevent the export of the total technological package necessary for making nuclear weapons is now lost to us, and the only recourse he sees lies in the development of agreement among the world's suppliers to "...conduct their trade on a basis that takes into account the consequences of providing additional countries with everything they need to make a bomb."** The possibilities for control vary, in his opinion, but in the end they will depend on agreement among the major industrialized supplier countries that further proliferation condemns us all to danger and insecurity.

A principal issue in these informal discussions is whether a supplier state should require the receiving state to place all of its nuclear activities under IAEA safeguards rather than just the materials and facilities covered by the export transaction. If the supplier nations would agree to this, it

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* July hearings, p. 14.

** Ibid., p. 51.

would offset the uncertainties caused by those nations which still will not ratify the NPT and place all their nuclear activities under IAEA safeguards. Another urgent issue is whether nuclear supplier nations should export enrichment and fuel reprocessing and fabrication technology equipment and facilities to any nation that wants them. The case of Brazil highlights this issue, for the West German Government apparently was willing to permit export of a virtually complete fuel cycle to Brazil, whereas U.S. Government would not permit the U.S. nuclear industry to do so.

The problem of differing attitudes among the governments of nuclear supplier countries was highlighted in testimony from the nuclear industry. One representative reported that competing overseas suppliers seem less restricted by government rules as to nuclear exports than ours, but noted also that without the influence of the United States, the international rules might be further watered down. This prospect will increase without an overall agreement among all suppliers on universally applied policies for nuclear exports.*

The need for consistent export policies among nuclear supplier states also was emphasized at the NPT review conference last May. The Conference urged that common export requirements for safeguards be strengthened, in particular by extending the applications of safeguards to all peaceful nuclear activities in importing states not party to the treaty.

While informal and secret negotiations may be necessary to reach quick agreement among nuclear suppliers to close a gaping loophole for

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* Cf., statement of A.L. Bethel, Westinghouse Electric Corp. Ibid., p. 64.

proliferation, it appears precarious to rely upon unpublished informal agreement as a long-term preventative. So the Subcommittee may wish to give attention to the progress of these negotiations and longer range plans to transform them into more binding international agreements.

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